Newton & the Leibniz-Clarke Correspondence

with notes on Newton, Conti, & Des Maizeaux

The « Leibniz-Clarke Correspondence » is one of the most interesting and most important documents of eighteenth century intellectual history. First published by Dr. Samuel Clarke in 1717 (1), these documents enable us to witness the serious confrontation of two opposing philosophies — Newton's and Leibniz's — on such major issues as the nature of space, the attributes of God, miracles, the world as a machine. Hence this particular fight took place on a more serious plane than the clash of two wounded vanities over priority in the invention of the calculus. Yet, as we shall see, the calculus question, with its direct challenge of plagiarism, fanned every fire of controversy between Leibniz and Newton to the rage of conflagration, and is thus part of the essential background for understanding any Leibniz-Newton question later than 1705 (2).

(1) *A Collection of papers which passed between the late learned Mr Leibnitz, and Dr. Clarke, in the years* 1715 *and* 1716. *Relating to the principles of natural philosophy and religion* (London : printed for James Knapton, 1717). This original edition was published « With an Appendix. To which are added, Letters to Dr. Clarke concerning Liberty and Necessity; From a Gentleman of the University of Cambridge [John Bulkeley]. With the Doctor's Answers to them. Also Remarks upon a Book, Entituled, A Philosophical Enquiry concerning Human Liberty [by Anthony Collins]. »

(2) A great desideratum would be a fresh and sound study of the Leibniz-Newton controversy, based on the original documents. For a chronology see pp. xxxvii sq. of J. Edleston : *Correspondence of Sir Isaac Newton and Professor Cotes* (London : John W. Parker, 1850). A convenient summary, though not accurate on every point, is given in Louis Trenchard More : *Isaac Newton, a biography* (New York : Charles Scribner's Sons, 1934), pp. 574 sq. In 1699, N. Fatio de Duillier published a statement that « Newton is the first inventor of this calculus » and hinted that Leibniz (« its second inventor ») might have « borrowed » something from Newton. In 1704, when Newton first published his *Opticks*, he added two mathematical tracts (*Tractatus duo de speciebus et magnitudine figurarum curvilinearum* namely, *Tractatus de Quadra-*

The correspondence between Leibniz and Clarke (3) began with a letter of November 1715 from Leibniz to his former pupil, the Princess of Wales, attacking Newton by way of expressing concern over the status of religion and philosophy in England. The princess « communicated excerpts of this letter to Clarke » (4), who drew up a reply which was sent to Leibniz; Leibniz answered this letter, Clarke replied again, and so on, until the exchange was interrupted by Leibniz's death in November 1716. Thus there are five « letters » from Leibniz and five replies by Clarke. Clarke was chosen to reply to Leibniz not only — or, not so much — because of his position at Court, or even because of his eminence as a scholar, theologian, and philosopher (5). Much more important was the fact that he was

tura Curvarum and *Enumeratio linearum tertii ordinis*, cf. Horsley's *Opera Omnia*, v. I, pp. 333-386 and 531-560), stating that he had « lent out a manuscript containing such theorems » (about « squaring curvilinear figures », or finding areas) and that he had « since met with some things copied out of it ». These tracts were reviewed in the Leipzig *Acta Eruditorum* for January 1705, the reviewer stating that « The elements of this calculus have been given to the public by its inventor Dr. Gottfried Wilhelm Leibniz ». Newton thought the reviewer was Leibniz who was implying that he had been a plagiarist and had taken the calculus from Leibniz. Three years later, John Keill wrote an account of « The laws of centripetal force », published in the *Philosophical Transactions* in 1708, in which it was stated that Newton's invention, « under a changed name and method of notation, was published by Doctor Leibniz in the *Acta Eruditorum* ». On 4 March 1710-11 Leibniz wrote a letter of complaint to the Royal Society. Keill wrote to Leibniz on 24 May, softening his charges, but not eliminating them altogether. On 29 December, therefore, Leibniz wrote again to Sir Hans Sloane, Secretary of the Royal Society, for satisfaction. The result was the *Commercium Epistolicum*, reported to the Royal Society on 24 April 1712 and published in the following January. The best edition of the *Commercium* was published in France under the editorship of J.-B. Biot and F. Lefort (Paris: Mallet-Bachelier, 1856).

(3) In the last few years there have been three editions of this correspondence : in English, French, and Russian.

H. G. Alexander, *The Leibniz-Clarke correspondence, together with extracts from Newton's* Principia *and* Opticks, *edited with introduction and notes* (Manchester : Manchester Univ. Press; New York : Philosophical Library, 1956); it contains on pp. lv-lvi a list of all previous editions.

André Robinet : *Correspondance Leibniz-Clarke présentée d'après les manuscrits originaux des bibliothèques de Hanovre et de Londres* (Paris : Presses Universitaires, 1957).

V I. Sviderski, i G. Kreber : *Polemika G. Leibnitsa i S. Klarka po voprosam filosofii i estestvoznaniia, 1715-1716* (Leningrad : Izd- vo Leningradskogo Univ., 1960).

(4) Letter from Leibniz to Bernoulli (June 1716), translated in Alexander, *op. cit.*, p. 189.

(5) Dr. Samuel Clarke (1675-1729) was appointed in 1709 Chaplain in ordinary of Queen Anne and, later, of Princess Caroline (Princess of Wales). He edited Caesar in 1712 (reprinted 11 times until 1831

a recognized, authoritative expositor of the Newtonian science (6), an old and trusted pupil and friend of Sir Isaac who could be relied

and Homer's *Iliad* in 1729 (reprinted 15 times); his *Odyssey* was published posthumously in 1740.

As theologian Dr. Clarke was a rather controversial figure — like his master, he was, practically, an Arian — and his celebrated treatise on *The Scripture-doctrine of the trinity* (London : printed for James Knapton, 1712) gave rise to « a great number of replies » and « occasioned a formal complaint from the Lower House of Convocations ». Clarke, however, managed to satisfy at least the authorities if not his critics.

As a philosopher Dr. Clarke is almost completely forgotten today; but in his own time he enjoyed a very high reputation : e. g., Voltaire, in his *Philosophie de Newton* (Part. I, chap. 2, p. 59, *Œuvres complètes*, vol. 41, Paris, 1837), places him, as philosopher and metaphysician, on the same level as Newton, or even above him. Clarke's writings were also very popular : thus the *Boyle Lectures* that he gave in 1704 on *The being and attributes of God*, and in 1705 on *The evidences of natural and revealed religion* (first printed separately, in 1705 and 1706, and afterwards published together under the title *A discourse concerning the being and attributes of God, the obligations of natural religion, and the truth and certainty of Christian revelation. In opposition to Mr. Hobbs, Spinoza, the author of the Oracles of reason...*) were not only reprinted many times (the 10th edition was published in London by J. & P. Knapton in 1749) but were translated into French (Amsterdam 1717, reprinted in 1727-28, and 1744). These lectures were also printed in Clarke's *Works* (first published in 1738; a 5th edition was issued in 1820). French editions of Clarke's *Œuvres philosophiques* were published in Paris in 1823 and in 1843. On Samuel Clarke, see Eugenio Garin, « Samuel Clarke e il razionalismo inglese del secolo XVIII », *Sophia*, 1934, 2 : 106-116, 294-304, 385-426.

Finally, it was well known that in philosophical questions the views of Dr. Clarke were in agreement with those of Sir Isaac. Cf. William Whiston, *Historical memoirs of the life of Dr. Samuel Clarke...* (London : sold by Fletcher Gyles and by J. Roberts, 1730), p. 155 : « Dr. Clarke's Philosophy was... generally no other than Sir Isaac Newton's Philosophy; tho' frequently applied by Dr. Clarke, with great Sagacity, and to excellent purposes, upon many Occasions. » This view was shared by Voltaire who, in his *Lettres philosophiques sur les Anglais* of 1726 quotes — or, rather, borrows from — Newton and Clarke indifferently, ascribing Clarke's views directly to Newton. The author of the article on S. Clarke in the *Encyclopaedia Brittanica*, 11th ed., p. 446, pointing out that the *Discourse concerning the being and attributes of God* appeared in 1705, i. e., long before the *Scholium Generale* of the second edition of the *Principia*, thinks that Clarke may have derived his « opinion that time and space are attributes of God » directly « from the Midrash, the Kabbala, Philo, Henry More or Cudworth, but not from Newton », whom he even might have influenced; cf. also G. V. Leroy : *Die philosophischen Probleme im Briefwechsel zwischen Leibniz und Clarke* (Mainz : Druck von Joh. Falk III. Söhne, 1893).

(6) It was Dr. Clarke who in 1697 translated into Latin — and stuffed with Newtonian additions — the *Traité de Physique* of the Cartesian J. Rohault, increasing the number and length of these additions with each subsequent edition : J. Rohault, *Physica* (London : Impensis Jacobi Knapton, 1697; later editions, 1702, 1710, 1712, 1718). Another edition was published in Leiden in 1739, with additions, by Charles Morgan.

upon correctly to represent the latter's views (7). Hence it is inconceivable that Dr. Clarke would, or could, have accepted this assignment without Newton's approval. Nor would he have carried it out without asking his master for advice and aid. We must also keep in mind that it was Newton *himself* who prepared the *Commercium Epistolicum* (8), that he then wrote an anonymous review of it for the *Philosophical Transactions* (9), and finally wrote an anonymous « Ad Lectorem » which was published with that review (« Recensio Libri ») in the second printing of the *Commercium* (10) ; would such a man merely have stood aloof, however great his confidence in Clarke, leaving Clarke to do his work without any direction or supervision?

As a matter of fact, there is no doubt that Newton took part in the fight between Leibniz and Clarke. Leibniz was convinced of it, and it is well known that Princess Caroline confirmed his « suspicion » that Clarke's replies « are not written without the advice of Chev. Newton » (11). As for ourselves, we have always been convinced that Newton had been deeply involved in the « Leibniz-Clarke Correspondence », that he not only received and studied

See George Sarton : « The study of early scientific textbooks », *Isis*, 1948, *38* : 137-148. The latin *Physica* of Rohault-Clarke was translated into English by Samuel's brother John as *Rohault's System of natural philosophy, illustrated with Dr. Samuel Clarke's notes taken mostly out of Sir Isaac Newton's philosophy* (London : printed for James Knapton, 1723; later editions, 1729, 1735). See M. A. Hoskin : « Clarke's notes to Rohault's *Traité* », *The Thomist*, 1961, 24 : 253-363.

(7) Clarke was designated by Newton to produce a Latin edition of the *Opticks*, published in 1706, in the preface of which (after a *confessio fidei newtonianæ*) he declares :

« Verum, quoniam Illustrissimo Authori visum est, librum hunc Sermone Anglico scriptum emittere, & in Præfatione sua cavere, nequis, se insciente, eum in alium sermonem converteret; Id hic certior faciendus est Lector, hanc Versionem & Authoris jussu incœptam, & eodem approbante absolutam; & quæcunq; in orationis contextu, majoris perspicuitatis gratia, aliquantulum immutata sint, paucula quidem illa, sed quæcunc; sint, ea omnia vel jussu Authoris vel ejusdem permissu esse immutata. »

(8) Newton's role in the preparation of the *Commercium Epistolicum* was first revealed by Augustus De Morgan.

(9) « An account of the book entituled *Commercium epistolicum Collinii & aliorum, De analysi promota*, published by order of the Royal Society, in relation to the dispute between Mr. Leibnits and Dr. Keill, about the right of invention of the new geometry of fluxions, otherwise call'd the differential method », *Philosophical Transactions*, 1715, No. 342 : 173-224.

(10) See I. Bernard Cohen : « Newton and recent scholarship », *Isis*, 1960, *51* : 507, n. 60.

(11) Caroline to Leibniz (10 Jan. 1716), quoted in Alexander, *op. cit.*, p. 193.

Leibniz's papers, but that he also collaborated fully with Clarke in his replies. We have to confess, however, that until recently our conviction was of a kind that is characterized as « moral certainty », that is, a conviction that leaves no place for doubt and yet lacks formal proof. Over a century ago Brewster told us, indeed, that he found among Sir Isaac's papers « many folio pages of manuscript containing the same views as those given by Dr. Clarke », but he did not publish them, nor did he quote from them. Specifically, Brewster limited Newton's participation to aid « on several astronomical points from Newton himself » (12). Today the situation has changed. By a study of the Newtonian manuscripts, the « moral » conviction has been transformed into a demonstrable one.

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It must be confessed, however, that we still have not found any written documents in Newton's hand that are either drafts of Clarke's replies, or suggestions as to what these replies should contain, or even versions of Clarke's replies with emendations or corrections by Newton. Considering the way in which Newton preserved his papers, the absence of any such documents may at first seem to contradict our firm declaration that the Newton MSS prove the degree of his participation. It must be kept in mind, however, that from 1712-1713 — the years in which Newton published the *Commercium Epistolicum* (13) and the second edition of the *Principia* — until Leibniz's death in 1716, Newton and Leibniz were engaged in a single set of quarrels on a number of different fronts

(12) Sir David Brewster : *Memoirs of the life, writings, and discoveries of Sir Isaac Newton* (Edinburgh : Thomas Constable and Co., 1855), vol. 2, p. 287. For a discussion of this question, see our « The case of the missing *tanquam* », *Isis*, 1961, *52* : 555-566, esp. p. 560. It may be that Brewster used the terms « mathematical » and « astronomical » in a loose sense, meaning scientific (physics) and cosmological; it may also be that Sir David, deeply concerned about Sir Isaac's orthodoxy, did not want to make Newton responsible for the general *philosophical* views of Dr. Clarke.

(13) See George J. Gray : *A bibliography of the works of Sir Isaac Newton*, together with a list of books illustrating his works (Cambridge : Macmillan and Bowes, 1888; second edition, considerably revised and enlarged, Cambridge : Bowes and Bowes, 1907); also *A descriptive catalogue of the Grace K. Babson Collection of the works of Sir Isaac Newton, and the material relating to him in the Babson Institute Library, Babson Park, Mass.*, with an introduction by Roger Babson Webber (New York: Herbert Reichner, 1950); a supplement compiled by Henry P. Macomber was published by Babson Institute in 1955.

simultaneously. Prior to 1713, Leibniz had attacked the Newtonian philosophy more than once, notably in his *Théodicée* (1710) and in a widely reprinted letter to Hartsoeker (1711) alleging that Newton had deserted the mechanical philosophy and had resorted to miracles and occult qualities (14). A portion of the concluding *Scholium Generale* to the second edition of the *Principa* was a direct response to Leibniz's letter to Hartsoeker and was the first statement in print by Newton himself in defense of his own philosophy against Leibniz (15). The latter's response to the new edition of the *Principia* may be seen in the anonymous review of that book that appeared in the *Acta Eruditorum* in 1714 (16). From Newton's MS notes it is plain that this book review was the immediate cause for the remarks comparing and contrasting the Newtonian and the Leibnizian philosophies at the conclusion of the anonymous *Recensio libri* that Newton wrote about the *Commercium* (17), the one published first in English in the *Philosophical Transactions* in

(14) See our article on « The case of the missing *tanquam* », *Isis*, 1961, 52 : p. 556, n. 2. We have in preparation a study of these letters of Leibniz and Hartsoeker, together with the text of the reply which Newton wrote but which has never been published.

(15) See J. Edleston : *Correspondence of Sir Isaac Newton and Professor Cotes* (London : John W. Parker, 1850), p. 153.

(16) Published anonymously in *Acta Eruditorum*, 1714 : 131-142. On p. 141, the reviewer says : « Coronidem operi eruditionis profundæ imponit scholion generale, in quo difficultates enarrantur, quibus vorticum hypothesis premi videtur celeberrimo Autori; nonnulla de Deo proferuntur; de causa gravitatis quædam indicantur & novæ cujusdam hypotheseos de spiritu quodam subtilissimo corpora crassa pervadente (eodem forte cum principio hylarchico *Henrici Mori*) mentio injicitur. » Emile Ravier : *Bibliographie des œuvres de Leibniz* (Paris : Librairie Félix Alcan, 1937), ch. III, does not include this review in his (admittedly incomplete) list of « comptes rendus anonymes » written by Leibniz. But can we not detect Leibniz's participation, if not authorship, in the reference to Henry More?

(17) Newton wrote (*Philosophical Transactions*, 1715, No. 342, p. 223) : « And after all this, one would wonder that Mr. *Newton* should be reflected upon for not explaining the Causes of Gravity and other Attractions by Hypotheses; as if it were a Crime to content himself with Certainties and let Uncertainties alone. And yet the Editors of the *Acta Eruditorum*, have told the World that Mr. *Newton* denies that the cause of Gravity is Mechanical, and that if the Spirit or Agent by which Electrical Attraction is performed, be not the *Ether* or *subtile Matter* of *Cartes*, it is less valuable than an Hypothesis, and perhaps may be the Hylarchic Principle of Dr. *Henry Moor :* and Mr. *Leibnitz* hath accused him of making Gravity a natural or essential Property of Bodies, and an occult Quality and Miracle. And by this sort of Railery they are perswading the *Germans* that Mr. *Newton* wants Judgment, and was not able to invent the Infinitesimal Method. » In notes to the paragraph, Newton refers specifically to the review, to Leibniz's *Théodicée*, and to Leibniz's Letter to Hartsoeker.

1715 and later in a Latin translation in the 1722 edition of the *Commercium* (18).

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The criticism made by Leibniz of the philosophical basis of Newtonian science was but one part of Leibniz's counterattack on the Newtonians for having accused him of plagiarism rather than original invention in the matter of the calculus. This is particularly noticeable in the exchange of views between Newton and Leibniz through an intermediary, the Abbé Conti, in 1715-1716, the very same years during which Leibniz was arguing with Clarke about the foundations and implications of the Newtonian philosophy. The topics discussed in these two controversies are so similar, being at times even identical, that the greatest caution has to be used in concluding that any given MS document belongs to one rather than another of these practically simultaneous sets of interchanges. And we submit that this indeed might well be the reason why there seem to exist no Newton-Clarke documents as such. After all, Newton and Clarke were both in London during the years of the « Leibniz-Clarke correspondence » and were certainly seeing much of each other; during the same years, 1715-1716, Newton was writing his own answers to Leibniz's various critiques of the Newtonian philosophy and composing his own arguments against the Leibnizian position. If Clarke had free access to these papers or even if he had only the opportunity to discuss these topics with Newton, there would have been no need for Newton actually to have put in writing a second time the substance of further replies to Leibniz for Dr. Clarke.

Since Leibniz's letters to Conti and to Princess Caroline were written at about the same time, we are not surprised to find that the charges against the Newtonian philosophy raised in them are all but identical. In the letter to Conti written in November or December 1715, Leibniz added a famous footnote or « apostille ». Together with other documents, the « apostille » was apparently published in 1716 or 1717 in a supplement (19) to some but not

(18) The 1722 edition was not a mere reprint with new prefatory and introductory material, but contained significant changes in the text proper.

all copies of the English and Latin editions (dated 1715) of Joseph Raphson's *Historia fluxionum* (20), together with a reply by Newton dated 26 Feb. 1715/16, a letter from Leibniz to Conti dated Hanover, 9 April 1716, and Newton's « Observations upon the preceding epistle ». These pieces, and others, were printed once again in the second volume of Des Maizeaux's *Recueil* (21), published in Amsterdam in 1720 (second edition: Amsterdam, 1740; third edition: Lausanne, 1759) (22).

The « apostille » began with a statement of how « ravi » Leibniz was that Conti was in England, where there were to be found « de très habiles gens ». The latter, alas, « voudroient passer pour être presque seules inventeurs, & c'est en quoy apparemment ils ne réussiront pas ». Then Leibniz discussed the *Commercium Epistolicum,* and declared : « Je suis fâché qu'un aussi habile homme que M. *Newton* s'est attiré la censure des personnes intelligentes, en déférant trop aux suggestions de quelques flatteurs, qui l'ont voulu brouiller avec moi » (23). Following this sort of preamble, Leibniz turned to Newton's philosophy, which — he said — « me paroit un peu étrange ». In the first place,

> Si tout Corps est grave, il faut necessairement (quoique disent ses deffenseurs & quelque emportement qu'ils témoignent) que la *Gravité* soit une *qualité occulte scholastique,* ou l'effect d'un *miracle.* J'ay fait voir autrefois à M. *Bayle,* que tout ce qui n'est pas explicable par la nature des creatures est miraculeux... Dieu agit continuellement sur les Créatures par la conservation de leurs natures, & cette conservation est une production continuelle de ce qui est perfection en elles. Il est *intelligentia supramundana,* parce qu'il n'est pas l'ame du Monde, & n'a pas besoin de *Sensorium.*

Next, Leibniz discussed the vacuum, atoms, space and time :

> Je ne trouve pas le *Vuide* demontré par les raisons de M. *Newton,* ou de ses Sectateurs; non plus que la prétenduë Gravité universelle, ou les Atomes. On ne peut donner dans le Vuide & dans les Atomes, que

(19) See *Descriptive catalogue of the Grace K. Babson Collection* (cited in Note 13 above), pp. 89-90.
(20) *See Gray's bibliography* (cited in note 13 above), nos. 266-267.
(21) This volume is discussed below in Appendix Three.
(22) This set of four letters is reprinted from Raphson's *Historia fluxionum* in volume IV of Samuel Horsley's edition of Newton's *Opera* (London : John Nichols, 1782), pp. 593-617.
(23) This and the following extracts from Leibniz are transcribed from vol. II of Des Maizeaux's *Recueil de diverses pièces... par Mrs. Leibniz, Clarke. Newton, & autre autheurs célèbres* (Amsterdam : chez H. Du Sauzet, 1720), pp. 5 sq.

> par des vûes trop bornées. M. *Clarke* dispute contre le sentiment des Cartesiens, qui croyent que Dieu ne sauroit détruire une partie de la matiere pour faire un vuide, mais je m'étonne qu'il ne voye point que si l'Espace est une substance differente de Dieu, la même difficulté s'y trouve. Or de dire que Dieu est l'Espace, c'est lui donner des parties. L'espace est quelque chose, mais comme le tems : l'un & l'autre est un ordre général des choses. L'Espace est l'ordre des coëxistences, & le tems est l'ordre des existences successives. Ce sont des choses véritables, mais ideales, comme les nombres.

Leibniz then turned to matter itself. Matter, he explained, is not a substance, « mais seulement *substantiatum* ». This led him to dynamics or the doctrine of forces. On this score, he said,

> ... je m'étonne que M. *Newton* & ses Sectateurs croyent que Dieu a si mal fait sa Machine, que s'il n'y mettoit la main extraordinairement, la Montre cesseroit bien-tôt d'aller. C'est avoir des idées bien étroites de la sagesse & de la puissance de Dieu. J'appelle *extraordinaire,* toute operation de Dieu, qui demande autre chose que la conservation des natures des Creatures. Ainsi quoi que je croye la Metaphysique de ces Messieurs-là, *a narrow one,* c'est-à-dire, *bornée* & leur Methematique assez *arrivable;* c'est-à-dire, *commune ou superficielle,* je ne laisse pas d'estimer extremement les Meditations Physico-Mathematiques de M. *Newton;* & vous obligeriez infiniment le public, Monsieur, si vous portiez cet habile homme à nous donner jusqu'à ses Conjectures en Physique. J'approuve fort sa Methode de tirer des Phenomenes ce qu'on en peut tirer sans rien supposer, quand même ce ne seroit quelquefois que tirer des consequences conjecturales. Cependant quand les *Data* ne suffisent point, il est permis (comme on fait quelquefois en déchifrant) d'imaginer des Hypotheses; & si elles sont heureuses on s'y tient provisionellement; en attendant que de nouvelles experiences nous apportent *nova Data,* & ce que *Bacon* appelle *experimenta crucis,* pour choisir entre les Hypotheses.

Leibniz had learned that certain Englishmen had badly represented his philosophy in their *Transactions;* thus he felt the need to state his position clearly. For instance, he insisted : « Je suis fort pour la Philosophie expérimentale. » Newton had deserted experimental philosophy, he held, when he alleged « que toute la matière est pesante (ou que chaque partie de la matière en attire chaque autre partie) que les expériences ne prouvent nullement, comme M. *Huygens* a déjà fort bien jugé ». Newton could display no experiment, « ni raison suffisante », for the vacuum and for atoms, nor for universal mutual attraction :

> Et parce qu'on sait pas encore parfaitement & en détail comment se produit la gravité ou la force élastique, ou la magnetique, *&c.* on n'a pas

raison pour cela d'en faire des Qualitez occultes scholastiques, ou des Miracles; mais on a encore moins raison de donner des bornes à la sagesse & à la puissance de Dieu, & de lui attribuer un *Sensorium*, & choses semblables. Au reste, je m'étonne que les Sectateurs de M. *Newton* ne donnent rien qui marque que leur maistre leur a communiqué une bonne Methode. J'ai été plus heureux en Disciples (24).

Conti's reply, dated from London, Mars 1716, did not deal with the major part of the « apostille », Conti merely remarking : « Je vous parlerai une autre fois de la Philosophie de Mr. *Newton*.» But he did enclose a « Lettre de M. le Chevalier Newton à M. l'Abbé Conti, servant de Réponse à l'Apostille de M. Leibniz ». The occasion of Newton's writing this reply is related by Brewster (25) and need not concern us overly. What is important is that Newton did compose a letter to Conti, dated 26 February 1715/16, which Conti sent on to Leibniz after some delay.

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Almost all of Newton's letter to Conti deals with the mathematical controversy, Newton taking the position that Leibniz's attempt to engage him in a philosophical debate bore no relation to the major issues of plagiarism and priority of discovery. Among the Newton MSS relating to the Leibniz controversy, containing more than a thousand pages in Newton's hand, there are many hitherto unpublished drafts of Newton's letter to Conti (26). One of them (27) reads as follows (28) :

(24) We have omitted, as irrelevant to the question in hand, the mathematical part of this « apostille », including a problem proposed by Leibniz « pour tâter un peu le pouls à nos Analystes Anglois ».

(25) See note 12 above. This topic is also discussed in Des Maizeaux's preface. See Appendix Three below.

(26) They are listed below in Appendix One.

(27) This MS is to be found in the Portsmouth Collection, the scientific portion of Newton's MSS that were given to the Cambridge University Library in the 1870's. The relationship between Newton and the Portsmouth family arose from the marriage of the daughter of Newton's niece (Catherine Barton Conduitt) to the first Viscount Lymington, son of the Earl of Portsmouth. See *A catalogue of the Portsmouth Collection of books and papers written by or belonging to Sir Isaac Newton, the scientific portion of which has been presented by the Earl of Portsmouth to the University of Cambridge* (Cambridge : at the University Press, 1888). The catalogue and classification of the papers were the work of a syndicate composed of H. R. Luard, G. G. Stokes, J. C. Adams, G. D. Liveing; the catalogue covers both the scientific MSS and correspondence deposited in the University Library and « the papers relating to Theology, Chronology, History, and Alchemy », which — after examination and study by the syndicate — were returned to Lord Portsmouth at Hurstbourne, where they remained until 1936, when they were dispersed at public auction. See [John Taylor :] *Catalogue of the Newton papers, sold by order of the Viscount Lymington, to whom they have descended from Catherine Conduitt, Viscountess Lymington, great-niece of Sir Isaac Newton* (London : Sotheby & Co., 1936). This MS text is to be found in Add. 3968, fol. 591 and fol. 589 in that order.

(28) In this and the following transcriptions, the symbols [— *i*]... [+ *i*] indicate matter inserted by Newton, almost always interlinearly.

In the latter part of his Postscript he [— *i*] departs from the Question & [+ *i*] falls foul upon my Philosophy as if I (and by consequence the ancient Phenicians & Greeks) introduced Miracles & occult qualities. And to make this appear he gives the name of *Miracles* or *Wonders* to the laws imprest by God upon Nature tho by reason of their constant working they create no *Wonder;* & that of *occult qualities* to qualities which are *not occult* but whose causes are occult tho the qualities themselves be very manifest. He saith that God is Intelligentia supramundana because if he were in the world he would be the soul of the world, that is, he would animate the world, & yet according to his Philosophy (that of an Harmonia praestabilita) the soul of a man doth not animate his body. He accuses me as if I affirmed that God hath a Sensorium in a litteral sense. He saith that I have not demonstrated a Vacuum nor universal gravity; but he denies conclusions without shewing the fault of the Premisses, & seems to mean that the argument of Induction from experiments upon wch experimental Philosophy is founded is not a demonstration [— *i*] & therefore ought to be rejected [+ *i*]. He saith also that I have not proved Atomes : but I have not affirmed them but place them among a set of Queries. He saith that Space is the order of coexistences & time the order of successive existences : I suppose he meanes that space is the order of coexistences in space, & time the order of successive existences in time, or that space is space in space & time is time in time. He calls the world Gods Watch, & insinuates that it is the fault of the workman & not of the [*a*] materials if a Watch will at length cease to go, & in like manner that it would be Gods fault if his Watch should ever decay & want an amendment. And by the same way of arguing a man may say that it would be Gods fault if matter doth not think. He applauds experimental Philosophy, but recommends Hypotheses to be admitted into Philosophy in order to be examined by experiments : whereas almost all his Hypotheses are uncapable of such an examination, & he should recommend not Hypoteses [*l*] to be admitted & beleived [*l*] before examination, but Questions to be examined & decided by experiments before they are admitted into Philosophy & proposed to be beleived. And whilst he applauds Eperimental [*l*] Philosophy & exclaims against Miracles, he introduces an Hypothesis of Harmonia præstabilita [*b*] which cannot be true without an [*c*] incredible Miracle, & is contrary to the daily experience of all mankind. For all men find by experience that they can move their bodies by their will, & that they see heare

& feel by means of their bodies. And if notwithstanding all this, he glories in the number of disciples, you know what his disciples are in England & that he has spent his life in keeping a general correspondence for making disciples, whilst I leave truth to shift for it self. ffor its about 40 years since I left off all corresponce by Letters about Mathematiks & Philosophy, & about 20 since I left off these studies [.] And for that reason I hope you will pardon me if I have been averse from writing this Letter & continue averse from being engaged in [*d*] disputes of this kind which make nothing to the Question in hand.

[*a*] : Watch *crossed out.* [*b*] : stabilita *changed to* praestabilita. [*c*] : Miracle *crossed out.* [*d*] : these *crossed out.*

Another (29) unpublished statement by Newton in reply to Conti reads *in extenso* as follows :

What he saith about Philosophy is foreign to the Question & therefore I shall be very short upon it. He denys conclusions without telling the fault of the premisses. His arguments [*a*] against me are founded upon metaphysical & precarious hypotheses & therefore do not affect me; for I meddle only with experimental Philosophy. He changes the signification of the words Miracles & Occult qualities that he may use them in railing at [*b*] [— *i*] universal gravity. [+ *i*] ffor Miracles are so called not because they [*c*] are the actions of God but because they [d] happen seldom & by happening seldom create wonder. If they happened constantly they would not be wonders. And occult qualities are decried not because their causes are unknown, but because [*e*] the Schoolmen, [— *i*] believed that [+ *i*] those things w^ch were unknown to their Master Aristotel, could never be known. He insinuates that I [*f*] ascribe to God a sensorium in a literal sense, w^ch is a [*g*] [— *i*] fiction [+ *i*] He [*h*] presents that God must be Intelligentia Supramundana least he should be the soul of the world & by the same way of [*j*] reasoning [*k*] [— *i*] a man [+ *i*] *may* [*l*] [— *i*] prove [+ *i*] that the soul of a man cannot be in his head least it should be the soul of the Images of Objects formed in the sensorium. He represents that [*m*] God has made this world so perfect that it can last eternally

(29) Portsmouth Collection Cambridge University Library, Add. 3968, fol. 587. It is possible that for his definition of « miracles » Newton was helped by Clarke, a professional theologian. As for Leibniz, he used his conception of miracle — something that is not explainable by natural causes — not only against attraction, but also against atoms. Indeed, matter being essentially divisible, it must be divisible *ad infinitum*. The existence of atoms, which would put an end to this divisibility, implies a special act of God's will and would thus be a miracle, he explained to Huygens 25 years before raising the accusation that Newton based his physics on miracles.
It is, by the way, rather amusing to see Newton believing (with Descartes) that the seat of the soul is in the head.

without needing any amendment because [— *i*] God [+ *i*] was able to make it so, & by the same way of arguing a man may prove that [*n*] matter can think. He pleads for Hypothetical [— *i*] Philosophy [+ *i*] because there may happen experiments to decide which of the [— *i*] Hypoteses [+ *i*] are true, & yet almost all his Philosophy consists [— *i*] in [+ *i*] Metaphysical Hyposeses [*l*] such as never were and never can be decided by experiments, & one of them (that of the Harmonia præstabilita) is contrary to the daily experience of all mankind. ffor every man finds in himself a power of moving his body by his will [*o*] Hypotheses may be propunded [*l*] by way of Questions [— *i*] to be examined by experiments [+ *i*] : but when they are prounded as Opinions to be beleived without examination, they [*p*] turn Philosophy into a Romance. He boasts of the number of his disciples, that is of his having spent all his life in keeping a correspondence with men of all nations, [*q*] to make disciples whilst I keep no such correspondence but leave truth to shift for it self.

[*a*] : are p *crossed out.* [*b*] : me *crossed out.* [*c*] : they *crossed out.* [*d*] : create *crossed out.* [*e*] : according to *crossed out.* [*f*] : make God to *crossed out.* [*g*] : mistake, & *crossed out.* [*h*] : p *crossed out.* [*j*] : argu *written above* reasoning *and then crossed out.* [*k*] : one *crossed out.* [*l*] : feigne *crossed out.* [*m*] : the *crossed out.* [*n*] : *An inkblot of word size may cover a word presently illegible.* [*o*] : *The following sentence is crossed out :* And if he is happy in disciples (as he boasts) it is because he has spent all his life in corresponding with men of all nations for propagating his opinions whilst I have [— *i*] rested & [+ *i*] left truth to shift for it self. [*p*] : are *crossed out.* [*q*] : whilst I keep no *crossed out.*

In the letter which Newton actually sent to Conti and which was printed by Raphson, most of the foregoing discussion was omitted. All that Newton had to say about philosophy as such was contained in the following two paragraphs (30) :

Hitherto Mr. Leibnitz avoided returning an answer to the *Commercium Epistolicum,* by pretending that he had not seen it. And now he avoids it, by telling you, that the English shall not have the pleasure to see him return an answer to their slender reasonings (as he calls them) and by endeavouring to engage me in disputes about Philosophy, and about solving of Problems; both which are nothing to the question.
As for Philosophy, he colludes in the significations of words, calling those things miracles, which create no wonder; and those things occult qualities, whose causes are occult, though the qualities themselves be manifest; and those things the souls of men, which do not animate their bodies. His *Harmonia Præstabilita* is miraculous, and contradicts

(30) Quoted from vol. IV of Newton's *Opera,* p. 598. In Des Maizeaux's *Recueil,* Newton's letter is printed in French translation, tome 2, pp. 17-18.

the daily experience of all mankind; every man finding in himself a power of seeing with his eyes, and moving his body by his will. He prefers hypotheses to arguments of induction drawn from experiments; accuses me of opinions which are not mine; and instead of proposing questions to be examined by experiments before they are admitted into Philosophy, he proposes hypotheses to be admitted and believed, before they are examined : but all this is nothing to the *Commercium Epistolicum.*

Leibniz, of course, could not let the matter rest at this point, and so in his reply to Conti (Hanover, 9 April 1716) he clarified his own position and answered Newton's criticism in these words (31) :

J'appelle *miracle* tout Evenement qui ne peut-être arrivé que par la Puissance du Createur, sa Raison n'étant pas dans la nature des Creatures : & quand on veut neanmoins l'attribuer aux qualités ou forces des Creatures, alors j'appelle cette Qualité *une Qualité occulte à la Scholastique;* c'est-à-dire, qu'il est impossible de rendre manifeste, telle que seroit une pesanteur primitive; car les Qualités occultes qui ne sont point chimeriques, sont celles dont nous ignorons la cause, mais dont nous ne l'excluons point. Et j'appelle *l'Ame de l'homme* cette Substance simple qui s'apperçoit de ce qui se passe dans le corps humain, & dont les Appetits ou Volontés sont suivis par les Efforts du Corps. Je ne prefére pas les *Hypotheses* aux *Argumens* tirez de l'induction des experiences : mais quelquefois on fait passer pour inductions générales ce qui ne consiste qu'en observations particulières; & quelquefois on veut faire passer pour une Hypothese ce qui est demonstratif. L'idée que M. *Newton* donne ici de mon Harmonie préetablie n'est pas celle qu'en ont quantité d'habiles gens hors de l'Angleterre, & quelques-uns en Angleterre; & je ne crois pas que vous même, Monsieur, en ayez eu une semblable, ou l'ayez maintenant, à moins que d'être bien changé.

Newton's observations on Leibniz's letter did not contain any further material on the rival philosophies, but was confined to mathematical questions and the dating of discoveries. But the main topics of the debate long remained alive for Newton and he referred to them again more than once. Summarizing the history of the controversy, some time after Leibniz's death, Newton wrote a memorandum stating the main points of Leibniz's attack on his philosophy (32) in which he said :

(31) Quoted from Des Maizeaux's *Recueil*, tome II, pp. 55-56.
(32) Portsmouth Collection, Cambridge University Library, Add. 3968, fol. 98.

About November or December 1715 Mr Leibnitz in a Letter to Mr l'Abbe Conti wrote a large Postscript relating to these matters, railling at the Commercium Epistolicum as attaquing his candor by false interpretations & omitting [*a*] what made for him or against [*b*] Mr Newton, & [— *i*] saying [+ *i*] that his adversaries should not have the pleasure to see him return an answer to their slender reasonings, & endeavouring to run the dispute into a squabble about universal gravity, [*c*] [— *i*] & occult qualities & miracles & Gods being not the soul of the world but [+ *i*] intelligentia supramundana [*d*] nor having need of a sensorium, & about atoms & the nature of [*e*] space & time, & about solving of mathematical Problems. All which are [*f*] [— *i*] digressions prevarications & evasions serve [+ *i*] to no other purpose than to avoid answering the Comercium Epistolicum...

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[a] : *Something illegible crossed out.* [b] : me *crossed out.* [c] : & Gods being *crossed out.* [d] : & not [— *i*] being [+ *i*] the soul of the world *crossed out.* e : *Something illegible crossed out.* [*f*] : prevarications serving *crossed out; probably Newton also intended to cross out* are.

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Now it should be observed that Leibniz's « apostille » was written in November or December 1715, that is, after Clarke's first reply, which is very brief (33). Newton's letter to Conti was dated 26 February 1715/16, some seven weeks after Clarke's second reply to Leibniz had been transmitted, at the time of Leibniz's « Third Paper, being an Answer to Dr. Clarke's Second Reply ». Hence the letters exchanged between Newton and Leibniz via Conti were written soon after Leibniz and Clarke had begun carrying on the first part of their correspondence. Small wonder, then, that the topics discussed in both series were identical. In Leibniz's « apostille », gravity is said to be a « scholastic occult quality, or the effect of a miracle ». God is said to « act continually on his creatures through the conservation of their natures... He is *intelligentia supramundana*... and has no need of a *sensorium* ». Leibniz found no real proof in Newton's arguments of the existence of a void, nor of universal gravity or atoms. He criticized Newton and his sectators for conceiving the world as a watch and believing that God the watchmaker had made his machine so badly that it

(33) Hence there is an error in chronology in our « The case of the missing *tanquam* », *Isis*, 1962, *52* : 557-558. We do not know exactly when (Dec., Jan., or Feb. 1715-1716) Newton began to draft a reply to Leibniz. Robinet, *op. cit.*, p. 41, dates Leibniz's letter to Conti 6 Dec. 1715 (Gregorian), or late November (Julian).

would « soon cease to go » if he did not tinker with it by some extraordinary means. Leibniz hoped Conti would get Newton to make public his recent conjectures in physics. Leibniz stated that when the data happened to be insufficient it was permissible to imagine hypotheses, waiting until experiments bring new data and until *experimenta crucis* (as Bacon called them) enable us to « choose between hypotheses ». Then he reiterated the main points of his criticism : Newton's departure from the experimental philosophy in claiming that « all matter is heavy (or that every part of matter attracts every other part) »; the « existence of a vacuum or of atoms or... the general mutual attraction »; making of gravity, elastic force or magnetic force « scholastic occult qualities or miracles » simply « because we do not yet know perfectly and in detail » how they are « produced »; putting « bounds to the wisdom and power of God » and attributing a sensorium to him; and, finally, failing to have had good pupils.

In a recent issue of *Isis*, Professors A. Rupert and Marie Boas Hall have printed a document which they suggest is a draft intended for Clarke (34), since the « topics of Newton's note — miracles, occult qualities, the proof of a deity from phenomena, Leibniz's intelligentia supramundana and *harmonia praestabilita*, the concept of animals as machines, the perfection of the universe — are all discussed by Clarke in the same light that Newton gives them here ». It is possible; though it seems to us much more likely that this document is a portion of one of the numerous drafts of Newton's letter to the Abbé Conti. The Professors Hall themselves have pointed out : « There is indeed no passage in Clarke's letters to Leibniz that precisely reflects Newton's note ». On the other hand, many of the parts of this note do appear *verbatim et litteratim* in one of the drafts of Newton's letter to Conti in reply to Leibniz's « apostille », even to the spelling « Aristotel » (35). Furthermore the note printed by the Professors Hall

(34) A. Rupert Hall and Marie Boas Hall : « Clarke and Newton », *Isis*, 1961, *52 :* 583-585.

(35) This note, as published in *Isis*, begins « For Miracles are so called not because they are the works of God, but because they happen seldom & for that reason create wonder. If they should happen constantly, according to certaine laws imprest *by the* upon the nature of things, they would be no longer wonders. » This may be compared with the fifth sentence of the draft to Conti published above (pg. 74). Other similar expressions in the note published in *Isis* are : « Occult qualities have been exploded not because their causes are unknown to us, but because... the great Philosopher Aristotel was not able to find

contains a portion crossed out by Newton, beginning : « But its said that hypotheses may in time meet with an Experimentum Crucis & Mr Leibnitz proposes Hypotheses for that end. » Since the discussion of « hypotheses » in relation to « ce que Bacon appelle *experimenta crucis* » specifically occurs in the « apostille » and not in Leibniz's letter to Clarke, it seems much more probable that this document is an early draft of a reply to Leibniz's « apostille » (36), and not a note or a draft intended specifically for Clarke.

Certainly, the hitherto unpublished drafts of Newton's letter to Conti about Leibniz's « apostille », such as we have just been examining, do exhibit many of Clarke's arguments against Leibniz. Thus they may be considered as a kind of documentary evidence that Newton must have participated closely in framing Clarke's replies to Leibniz — if only to the extent of showing him, or discussing with him, the arguments that Newton himself had written out but had not sent to Conti; just as Newton would have been shown Clarke's replies to Leibniz and would surely have discussed them with Clarke.

We do not rule out the possibility that in discussing the replies to Leibniz, Clarke must have made a real contribution of his own, and did not act merely as Newton's secretary. We have found no evidence to make precise the degree of either Newton's participation in the « Leibniz-Clarke correspondence » or of Clake's participation in Newton's letters to Conti.

Now it must be confessed that we are not the first to see the close connection — not only in time, but also in content — between the Leibniz-Clarke exchanges and the Leibniz-Conti-Newton letters. Des Maizeaux, about two and a half centuries ago, had already said of Leibniz's « apostille » (37) :

them out. But Mr Leibnitz alters & enlarges the signification of these words Miracles & Occult Qualities... » « At the same time he is propounding Hypotheses... (not Quaeres to be examined by experiments but praecarious... opinions to be believed without any proof) which turn Philosophy into a Romance. » Cf. App. I, *infra*, No. 11.

(36) See Appendix One.

One of the points made by the Professors Hall is that in the note they have printed, Newton used « both the first person and (anomalously) "Mr. Newton" ». One of the drafts (see Appendix One, Draft No. 5) of Newton's letter to Conti, is written in the third person (« Mr. Newton »), and then partially altered to the first person (« I »).

(37) Quoted from Des Maizeaux's preface (original edition, Amsterdam, 1720), vol. 1, pp. lix-lx; it appears unchanged in subsequent editions.

M. LEIBNIZ attaque après cela M. NEWTON sur *sa Philosophie :* il critique ses Sentimens sur la *Gravité,* ou Pesanteur des Corps; sur le *Vuide;* sur l'*intervention de Dieu* pour la conservation de ses Creatures, &c. Il l'accuse de ramener les *Qualitez occultes* des Scholastiques, ou de supposer perpétuellement des *Miracles* &c. On voit que ce sont là les mêmes Difficultez, qui font le sujet de sa Dispute avec M. CLARKE.

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The Conti material is but one of four parts of the MS evidence we have found of Newton's direct participation in the Leibniz-Clarke exchange. A second bit of evidence is concerned with a long note printed by Clarke as an extension of his remarks in his « Fifth Reply » (§§ 93-95). The question at issue was (Clarke's « Fourth Reply », § 33) the communication of motion : whether « giving a new force » is « supernatural » and hence if « every action of God is supernatural... he is quite excluded from the government of the natural world » (38). Thus « every action of man, is either supernatural, or else man is as mere a machine as a clock ». Leibniz's reply gave, as an example, the collision of bodies (« Fifth Paper », §§ 93-95) « as when two equal hard bodies meet directly » and « each of them preserves its force ». Clarke's reply invoked the general subject of collisions and the problem of what is meant by the « force of bodies in motion ». This, in turn, led to the distinction between the « correct » Newtonian concept of momentum (« quantity of motion » mv) and the allegedly « incorrect » Leibnizian insistence on what he called *vis viva* (mv^2) and what we would call work (or kinetic energy, measured by the distance through which the force acts, or by the square of the speed rather than the speed itself). The language used by Clarke is colorful, as witness : « The reason of his inconsistency in this matter, was his computing, by a wonderfully unphilosophical error, the quantity of impulsive force... » This sentence, like a number of others in Clarke's note, are to be found almost *verbatim et litteratim* in a pair of MS memoranda written by Newton. Furthermore, the major arguments against the physical principles of Leibniz, which Clarke develops in this note, are seen to have been derived from Newton. The evidence is presented in full, below, in Appendix Two.

A third item of evidence is a single sheet in the Newton papers

(38) Quoted from Alexander's edition, pp. 51 (§ 33), 86 (§§ 93-95), 110 (§ 93-95), 121-125.

among the materials relating to Des Maizeaux (39) in the Portsmouth Collection (Add. 3968, section 36, fol. 517). Written in Newton's hand in French, it is headed « P.S. ». In a later hand, the following note has been added : « This Postscript is printed at y^e^ end of M^r^ Leibnitz's Fourth Paper ag^t^ D^r^ Clarke ». This postcript was first printed, however, in Dr. Clarke's own edition (London, 1717), pp. 115-119. It is written in a most condescending tone, beginning (we quote from Clarke's edition) :

> Tous ceux qui sont pour le Vuide, se laissent plus mener par l'Imagination que par la raison. Quand j'étois jeune garçon, je donnay aussi dans le vuide & dans les Atomes; mais la raison me ramena. L'Imagination étoit riante...

According to the evidence assembled by Alexander, Leibniz's « Fourth Paper » was sent with a letter dated 2 June 1716. But this postcript was a reply to Caroline's mention of vacuum experiments in yet another letter (4/15 May 1716); it was a postscript « to a private letter to Caroline, dated 12th May 1716 » (40). At the bottom of his copy of this postscript, Newton has added this note in his own hand : « Received of y^e^ Princess May 7th 1716, & copied May 8. » Hence we have here unchallengeable evidence that Newton was kept au courant of each of the developments in the Leibniz-Clarke discussion. The apparent discrepancy in dates (Newton seeming to have received Leibniz's letter from Princess Caroline before Leibniz had written it) derives, of course, from the difference in date between the Continental Gregorian and the British Julian calendars.

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Let us next turn to the fourth bit of evidence concerning Newton's involvement in Clarke's correspondence with Leibniz. We shall not study this correspondence in its entirety (41), but shall rather fix our attention on a letter — or an *Avertissement au Lecteur* — quoted by Des Maizeaux in his Preface to the re-edition of the « Leibniz-Clarke Correspondence » published by him in 1720

(39) See, below. Appendix Three.
(40) Alexander : *op. cit.*, pp. 36 (n. 1), 43 (n. 1); Robinet : *op. cit.*, pp. 76, 83.
(41) For an analysis of some of the main issues, see A. Koyré : *From the Closed World to the Infinite Universe* (Baltimore : The Johns Hopkins Press, 1957).

in Amsterdam, together with some other texts and documents of the Leibniz-Newton affair (42).

In his Preface, dated « Londres, le 27. d'Octobre 1719 », Des Maizeaux begins by recounting the origin and history of the *Collection of Papers which passed between... Mr. Leibnitz and Dr. Clarke* (43). Thus he refers to Leibniz's letter to the Princess of Wales (Nov. 1715) in which, according to Des Maizeaux (44) :

M. Leibniz attaqua la Philosophie de M. Newton... Il se prévalut d'une expression susceptible de plusieurs sens (*sensorium,*) pour accuser M. Newton d'attribuer à Dieu un Organe, par lequel il aperçoit les choses. Il prétendit aussi, que M. Newton ravaloit la Sagesse et la Puissance de l'Etre supréme, en disant qu'il se trouvoit obligé de redresser de tems en tems la Machine du Monde, pour y entretenir de l'ordre & de la régularité : comme un Horloger a besoin de remonter de tems en tems sa Montre, sans quoi elle cesseroit d'agir.

Madame la Princesse de Galles, accoûtumée aux Recherches Philosophiques les plus abstraites, & les plus sublimes, fit voir cette Lettre à M. Clarke, & souhaita qu'il y répondit. Son Altesse Royale jugea bien qu'une Dispute qui rouloit sur des matières si importantes, & qui se

(42) In the first edition, in two volumes, volume one contained a dedicatory *epître* (à Monsieur Hans Sloane), a preface, the text of the Leibniz-Clarke correspondence, with the appendix of Leibniz texts published by Clarke in his edition, and some other works by Clarke as in the original edition; see footnote 1 above. Volume two contained the « apostille » to Leibniz's letter to Conti, Conti's reply, a French translation of Newton's letter to Conti (replying to Leibniz), a letter from Leibniz to Conti (14 April 1716), Leibniz's letter to la Comtesse de Kilmansegger, the « apostille » of a letter from Leibniz to M. le Comte de Bothmer, Leibniz's response to Newton's letter to Conti (in a letter of his own to Conti), a letter of Leibniz to M. Remond, Newton's remarks on Leibniz's letter to Conti in response to Newton's letter, another letter from Leibniz to M. Remond, a letter from Leibniz to Chamberlayne, and another letter from Leibniz to Chamberlayne. Following two pages of errata, many deriving from Newton (see Appendix Three), the remaining half of the volume was devoted to « Lettres et opuscules de M. Leibniz ».

(43) *Recueil,* 1720 edition, vol. 1, pp. I-lxxxi. Des Maizeaux's *résumé* is very interesting, if only for the fact that he is completely silent about Newton's role in the polemics. Des Maizeaux's Preface, by the way, was not published in the second English edition of the *Correspondence* in vol, III of the edition of Clarke's *Works* printed in London in 1739. Our quotations are taken from the first edition.

(44) *Recueil,* 1720, vol. 1, p. *i.* The same ironic comparison was made by Leibniz in the « apostille » to his letter to the Abbé Conti (end of 1715); in this letter he also raised against Newton the « accusation » of endowing God with a *sensorium.* In a letter to Des Maizeaux (21 août 1716) Leibniz expressed his hope that « il y a beaucoup de gens en Angleterre, qui ne seront pas de l'avis de M. Newton ou de M. Clarke sur la Philosophie, & ne goûteront point les Attractions proprement dites; ni le Vuide; ni le *Sensorium* de Dieu... » (*Recueil,* 1720, vol. 2, p. 357).

trouvoit en de si bonnes mains, pourroit donner lieu à des éclaircissemens considérables : & pour animer d'avantage cette espece de Combat Philosophique, elle voulut qu'il se fit, pour ainsi dire, sous ses yeux. Elle envoyoit à M. Leibniz les Réponses de M. Clarke, et communiquoit à M. Clarke les nouvelles Difficultez ou les Instances de M. Leibniz. Les matières se multiplioient à mesure que la Dispute avançoit. M. Leibniz en vint à des objections contre *l'Attraction* mutuelle des Corps : il traita de la nature des *Miracles;* du *Libre,* et du *Volontaire;* de la *Force des Corps* qui se meuvent : il s'étendit particulièrement sur la nature de l'*Espace,* du *Tems,* et de la *Durée.* Il rejetta absolument le *Vuide,* ou *l'Espace réel absolu :* regardant l'*Espace* comme une pure Relation. Ce n'est, dit-il, que *l'Ordre* ou *l'Arrangement des Corps :* c'est *l'Ordre des Situations,* ou des *Coëxistences,* c'est-à-dire, *des choses qui coëxistent;* comme le *Tems* est *l'Ordre des Successions,* ou *des choses qui se succedent l'une à l'autre* (45).

M. Clarke [continues Des Maizeaux] répondit à toutes ces Difficultez avec beaucoup de clarté & d'exactitude. Il soûtint, par exemple, que *l'Espace* n'est pas une simple Relation d'une chose à une autre, qui resulte de leur situation, ou de l'ordre qu'elles ont entr'elles : mais que c'est une *Qualité* ou *Proprieté,* de la même manière que la *Durée. L'Espace infini* ou *l'Immensité,* est une propriété de la Substance qui est immense; comme la *Durée infinie* ou *l'Eternité,* est une proprieté de la Substance qui est éternelle : ou pour mieux dire, ce sont des suites de l'Existence d'un Etre infini & éternel (46). Cependant, comme les termes de *Qualité* ou de *Proprieté,* ont d'ordinaire un sens different de celui dans lequel il les faut prendre ici : M. Clarke a souhaité que j'avertisse ses Lecteurs, que « lorsqu'il parle de *l'Espace infini* ou de *L'Immensité,* & de la *Durée infinie* ou de *l'Eternité;* & qu'il leur donne, par une imperfection inévitable de language, le nom de *Qualitez* ou de *Proprietez* de la Substance qui est immense, ou éternelle; il ne prétend pas prendre le terme de *qualité* ou de *proprieté,* dans le même sens que le prennent ordinairement ceux qui traitent de la Logique, & de la Metaphysique lors qu'ils les appliquent à la Matière : mais que par là, il veut seulement dire, que *l'Espace* & la *Durée* sont des *Modes d'existence* dans tous les Etres; & des *Modes infinis,* & des *Conséquences,* de *l'existence* de la Substance qui est réellement, nécessairement, & substantiellement *toute-presente, & éternelle.* Cette *Existence* n'est point une Substance; & elle ne sauroit être raportée à aucune espece de *qualité* ou de *proprieté :* mais c'est la Substance même avec tous les *attributs,* toutes ses *qualitez,* & toutes ses *proprietez :* & le *Lieu,* & la *Durée,* sont des *Modes* de cette existence, de telle nature, qu'on ne sauroit les rejetter sans rejetter l'Existence elle-même. Lorsque nous parlons de

(45) We shall not deal here with the polemics about gravity (« miracle » and « occult quality ») since we discuss this question elsewhere.

(46) At this point, Des Maizeaux introduced a footnote, giving a cross-reference as follows : « Voyez la Remarque de M. Clarke sur sa *V. Replique,* § 36-38, tom. 1, pag. 163 & suiv. »

choses qui ne tombent pas sous nos sens; il est difficile d'en parler sans se servir d'expressions figurées ».

In his summary of Clarke's answer to Leibniz, Des Maizeaux refers us to Clarke's *fifth* Reply to Leibniz's *fifth* Paper (§§ 36-42). In this passage, however, Clarke sends us back to § 11 of his own *fourth* Reply, which in turn refers us to § 3 of his *third* Reply. We shall, for our part, reverse this order and start with III, § 3, and the remarks of Leibniz to which it replies.

⁂

In his *third* Paper, developing his criticism of the Newtonian conception of space, « Idole de quelques Anglais modernes », Leibniz writes : « Ces Messieurs soutiennent donc, que *l'Espace* est un *Etre réel absolu;* mais cela les mene à de grandes difficultez. Car il paroit que cet Etre doit être eternel & infini. C'est pourquoi il y en a qui ont crû que c'était Dieu lui même ou bien son Attribut, son Immensité. Mais comme il a des parties, ce n'est pas une chose qui puisse convenir à Dieu » (47). The only way to avoid this divinisation of space or spatialisation of God, Leibniz continues, is to adopt his own relational theory that reduces space to a simple « order of co-existence » (as time, another idol, is reduced to an « order of succession ») (48).

We shall not deal here with Leibniz's conception of space. We must remember, however, that he was not the only, nor even the first, philosopher to object to the Newtonian conception of absolute space on metaphysical and theological grounds. Indeed, some years earlier, in 1710, Berkeley voiced the same misgivings. Thus, in the *Principles of Human Knowledge*, having given a careful and very precise account of Newton's conception of absolute space and having subjected it to a searching criticism (49), Berkeley opposed to it his own conception, which denies its existence, and concluded (§ 117, p. 93) :

(47) Third paper, § 3. We shall quote the « papers » by paragraph numbers (§§), which are the same in all editions; we shall quote Leibniz's papers in the original French as printed by Des Maizeaux (1720 edition). For a history of the Leibniz texts, see Robinet's edition, cited above, n. 3.

(48) We have printed above, page 73, Newton's comments on this concept of Leibniz; see also Appendix One, below.

(49) Cf. *Principles of human knowledge*, §§ 110 sq.; *The works of George Berkeley, Bishop of Cloyne*, ed. A. A. Luce and T. E. Jessop (Edinburgh : Thomas Nelson, 1949), vol. 2, p. 89.

What is here laid down, seems to put an end to all those disputes and difficulties, which have sprung up amongst the learned concerning the nature of *pure space*. But the chief advantage arising from it is, that we are freed from that dangerous *dilemma*, to which several who have employed their thoughts on this subject, imagine themselves reduced, to wit, of thinking either that real space is God, or else that there is something beside God which is eternal, uncreated, infinite, indivisible, immutable. Both of which may justly be thought pernicious and absurd notions. It is certain that not a few divines, as well as philosophers of great note, have, from the difficulty they found in conceiving either limits or annihilation of space, concluded it must be *divine*. And some of late have set themselves particularly to shew, that the incommunicable attributes of God agree to it. Which doctrines, how unworthy soever it may seem of the Divine Nature, yet I do not see how we can get clear of it, so long as we adhere to the received opinions.

The « ces Messieurs » to whom Leibniz alludes are, obviously, Newton himself and Clarke. Newton, according to Leibniz, makes space a *sensorium Dei* and thus endows God with organs — the accusation that started the polemics (50) — and Clarke espouses his views (51). But who are these other modern Englishmen for whom space is an « idol » and who believe that it is God or an attribute of God? Leibniz does not give us their names (Berkeley does not either), and we are thus reduced to making « hypotheses ».

Leibniz may have been thinking of Dr. George Cheyne (whom Berkeley certainly had in mind). In his *Philosophical Principles of Natural Religion* (London, 1705; 2nd ed., *ib.*, 1715) Cheyne expressed views very similar to those of Sir Isaac, asserting (as Cotes was to do in his *Preface* to the 2nd edition of the *Principia*) that gravity

(50) See our « Case of the missing *tanquam* », *Isis*, 1961.

(51) In his *Demonstration of the being and attributes of God* (London, 1705; we quote from the seventh edition, London: printed for W. Botham and J. Knapton, 1728) Clarke tells us (prop. VI, p. 43) that « The *Self existing being must of necessity be Infinite and Omnipresent.* » « From hence it follows [p. 44].

« 1st. That the Infinity of the Self Existent Being must be an Infinity of *Fullness* as well as of *Immensity*.

« 2dly. From hence it follows that the Self-Existing Being must be a most *Simple, Unchangeable, Incorruptible* Being; without *Parts, Figure, Motion, Divisibility* or any other such properties as we find in Matter. For all these things do plainly and necessarily imply Finiteness in their very Notion, and are utterly inconsistent with complete Infinity. Divisibility is separation of Parts real or mental... [and not simple distinction] for Space, for instance, which is absolutely indivisible and inseparable either really or mentally, may yet be partially apprehended. »

was a « primary » property of matter and that space was God's *sensorium* (52).

Most probably (since Berkeley alludes to him also) Leibniz was referring to Joseph Raphson, who in his *De Spatio Reali seu Ente Infinito* (53) (London, 1702) pushed the divinisation of space to its last limit, or even somewhat beyond (54); and last but not least, to

(52) Cf. George Cheyne, *Philosophical Principles of natural Religion:* first printed in 1705, reprinted in Cheyne's *Philosophical principles of religion: natural and reveal'd* (London: printed for G. Strahan, 1715). Part II, def. IV, p. 4 : « A Spirit is an extended, penetrable, active, indivisible, intelligent Substance. » Corr. IV, p. 53 : « *Universal Space* is the Image and Representation in Nature of the *Divine Infinitude.* » Corr. V, p. 53 : « Hence *Universal Space* may be very aptly called the *Sensorium Divinitatis* since it is the Place where all natural Things, or the whole *System* of material and compounded Beings is presented to the *Divine Omniscience.* » *Ibid.*, Part I, p. 41 : « *Attraction* or *Gravitation* is not *essential* to Matter, but seems rather an *original Impress* which continues in it, by virtue of the *Omnipotent* Activity in the *Divine Nature* of which it is a *Copy* or an *Image* in the low Degree suitable to a gross creature, and so may now be reckon'd among the *primary* Qualities of Matter, without which, as it is now constituted Matter cannot be. » *Ibid.*, p. 42, Gravity is not to be explained mechanically. According to Dr. Cheyne, the attribution of attraction to matter as an essential property implies that the world is self-sufficient, just as the attribution to matter of spontaneous mobility [e. g., by Toland], and thus leads to atheism.

(53) Cf. Joseph Raphson, *De spatio reali seu ente infinito conamen mathematico-metaphysicum,* which appeared as an appendix to the second edition (London : J. Taylor, 1702) of his *Analysis æquationum universalis seu ad æquationes algebraicas resolvendas methodus generalis et expedita...* Raphson says (cap. IV, p. 71, cor. 3) : « ... everything of which the essence implies an absolute infinity pertains necessarily to the *absolutely Infinite* Being... » Space is defined (Def. I, p. 72) as « the *Innermost Extended* (whatever it be) which is the *first* by nature and the very last to be obtained by continuous division and separation ». Wherefrom follow (pp. 74 sq.) :

« Prop. 1. *Space* (or the *innermost extended*) is, by its nature, absolutely indivisible and cannot be conceived as divided. 2. *Space* is absolutely, and by its nature, unmovable. 3. *Space* is actually infinite. 4. *Space* is pure act. 5. *Space* is all containing and all penetrating », and (*scholium,* p. 76) : « doubtlessly this is the reason why for the Hebrews the name of the *Infinite* was MAKOM; as it is that of St. Paul's « it is nearer to us that we are to ourselves. » »

This being so, we are hardly surprised to learn that (*ibid., corollarium*) :

« 9. *Space* is eternal »; that (*ibid.*, p. 78) « 12. Extended things can neither be nor be conceived without it. » And that « therefore 13. *Space* is an attribute (namely the Immensity) of the *First Cause.*

Finally, following More, and even going beyond him (cf. note 55), Raphson declares (p. 85) that « The Infinite Amplitude of extension expresses the immense diffusion of Being in the *First Cause,* or its infinite and truly interminate essence ».

(54) In his *Demonstration* etc., Clarke writes obviously with Raphson in mind (prop. IV, p. 39) :

« *Of Infinite Space* — 1st. *The weakness of such, as have presumed*

Henry More who inspired them all and who in several of his writings, but especially in his *Antidote against Atheism,* and the *Enchiridion Metaphysicum* (55), asserted the substantial character of infinite space, or else made it an attribute of God.

to imagine Infinite Space to be a just Representation or the adequate Idea of the Essence of the Supreme Cause... Infinite Space is nothing else but abstract Immensity or Infinity; even as infinite Duration is abstract Eternity. And it would be just as proper, to say that Eternity is the Essence of the Supreme Cause; as to say, that Immensity is so. Indeed they seem both to be *Modes* of an Essence or Substance incomprehensible to us. »

(55) Cf. Henry More, *An antidote against atheism or an appeal to the natural faculties of the minde, whether there be not a God* [London, 1652], third edition « Corrected and enlarged with an Appendix thereunto annexed » (London : W. Morden, 1662), Appendix, Cap. VII, pp. 163 sq. : « If there were no *Matter,* but the Immensity of the Divine Essence only, occupying all by its Ubiquity, then *the Replication,* as I may so speak, of his [God's] indivisible substance, whereby he presents himself intirely every where, would be the Subject of that Diffusion and Mensurability.

« And I adde further, that the perpetual observation of this infinite Amplitude and Mensurability, which we cannot disimagine in our Phansie but will necessarily be, may be a more rude and obscure Notion offered to our Mind of that *necessary* and *self-existant* Essence which the *Idea* of God does with greater fulness and distinctness represent to us. For it is plain that not so much as our Imagination is engaged to an appropriation of this *Idea* of *Space* to corporeal *Matter,* in that it does not naturally conceive any impenetrability or tangibility in the Notion thereof; and therefore it may as well belong to a *Spirit* as to a *Body.* Whence, as I said before, the *Idea* of God being such as it is, it will both justly and necessarily cast this ruder notion of *Space* upon that Infinite and Eternal Spirit which is God.

« For if after the removal of *corporeal Matter* out of the world, there will be still *Space* and *Distance* in which this very Matter, while it was there, was also conceived to lye, and this *distant Space* cannot but be something, and yet not corporeal, because neither impenetrable nor tangible; it must of necessity be a Substance Incorporeal necessarily and eternally existent of itself : which the clearer *Idea* of a *Being absolutely perfect* will more fully and punctually inform us to be the *Self-subsisting God.* »

Enchiridion metaphysicum (London : typis E. Flesher, 1672), Cap. VIII, § 6, p. 68 : « A real attribute of any subject can never be found anywhere but where some real subject supports it. But extension is a real attribute of a real subject (namely matter) which however is found elsewhere and which is independent of our imagination. Indeed we are unable not to conceive that a certain immobile extension pervading everything in infinity has always existed and will exist in all eternity (whether we think about it or do not think about it) and is nevertheless really distinct from matter.

« It is therefore necessary that, because it is a real attribute, some real subject support this extension. » Otherwise, « it would be possible for real attributes to be present without there being any real subject to support them. » This real subject can, obviously, be nothing but God. Indeed all the ontological « properties » of Space, such as infinity, eternity, indivisibility, unity and so on are identical with those that metaphysicians attribute to God. More therefore (*ibid.,* cap. VIII,

We have to point out, however, that Newton himself, though doubtlessly influenced by More and in his wake closely connecting space and God (as in the *General Scholium* of the second edition of the *Principia : existendo semper & ubique durationem & spatium constituit*), did not identify God and Space (cf. *ibid. : non est duratio vel spatium*). Moreover, Newton neither asserted that Space was a substance, nor that it was an *attribute* of God (56), as Leibniz had maliciously insinuated (57).

Clarke was right, therefore, to reply that, according to Newton, « *Space* is not a *Being*, an eternal and infinite *Being*, but a *Property* or a consequence of the Existence of a Being infinite and eternal. *Infinite Space*, is *Immensity :* But *Immensity* is *not God :*

pp. 69 sq.) proceeds to the « *Enumeration of about twenty titles which the metaphysicians attribute to God and which fit the immobile extended or internal place* (LOCUS).

« There are not less than twenty titles by which the Divine Numen is wont to be designated, and which perfectly fit this infinite internal place (*locus*) the existence of which in Nature we have demonstrated, omitting moreover that the very Divine Numen is called by the Cabbalists MAKOM, that is Place (*locus*). Indeed, it would be astonishing and a kind of Prodigy if a thing about which so much can be said proved to be a mere nothing. »

(56) In his early paper *De gravitatione et æquipondio fluidorum* (published by A. Rupert and Marie Boas Hall : *Unpublished scientific papers of Isaac Newton...*, Cambridge : at the University Press, 1962, p. 99), Newton — as before him Gassendi and Barrow (cf. *Lectiones geometricæ* of 1662, reprinted Cambridge, 1860, p. 150) — wrote that the division of being into Substance and Accident does not apply to Space which « habet quendam sibi proprium existendi modum qui neque substantijs neque accidentibus competit ». In the same paper, criticising Descartes for making « extension » an attribute of material substance only and asserting that it belongs to all kinds of substances, spiritual as well as material, Newton uses the term *Affectio* stating that « *extensio est entis quatenus entis affectio* » (p. 103).

(57) Leibniz asserted the proximity of Newton's and More's conceptions of Space in the review of the second edition of the *Principia* that he published, anonymously, in the *Acta Eruditorum* of 1714, pp. 141, 142, from which we have quoted above in note 16. The attribution of this review to Leibniz is based by us largely on the reference to Henry More.

As we have seen above, Newton resented this identification of his « spirit » with the « hylarchical principle » of Henry More; he felt rightly that More was much too « romantic » an author — he believed in ghosts, apparitions, etc., etc., — to be associated with. Thus Newton protested against Leibniz's « insinuation » in his own review of the *Commercium epistolicum* (*Philos. Transactions*, 1714); see note 17 above. Moreover, in the Newtonian metaphysics there was really no place for the « hylarchical principle, » an entity mediating between God and the world. The Newtonian God did not need such a mediator: he acted himself.

And therefore, *Infinite Space*, is not *God* » (58). He was also right to insist that Newtonian absolute space was not divisible :

Nor is there any Difficulty in what is here alleged about Space having *Parts*. For Infinite Space is *One*, absolutely and essentially *indivisible :* And to suppose it *parted*, is a contradiction in Terms; because there must be Space in the *Partition it self :* which is to suppose it *parted*, and yet *not parted* at the same time. The *Immensity* or *Omnipresence* of *God*, is no more a dividing of his Substance into *Parts;* than his *Duration*, or continuance of existing, is a dividing of his existence into *Parts* (59).

Confronted with Clarke's vigorous defense of the Newtonian position, Leibniz shifted somewhat the point of attack, directing it against the conception of void space (*fourth* paper, §§ 8, 9, 10) :

8. Si l'Espace est une proprieté ou un attribut, il doit être la proprieté de quelque substance. L'Espace vuide borné, que ses patrons supposent entre deux Corps, de quelle substance sera-t-il la proprieté ou l'affection?

9. Si l'Espace infini est l'immensité; l'Espace fini sera l'opposé de l'immensité, c'est-à-dire, la mensurabilité ou l'étenduë bornée. Or l'étenduë doit être l'affection d'un étendu. Mais si cet Espace est vuide, il sera un attribut sans sujet, une étenduë d'aucun étendu. C'est pourquoi, en faisant de l'Espace une proprieté, l'on tombe dans mon sentiment qui le fait un ordre des choses, & non pas quelque chose d'absolu.

10. Si l'Espace est une realité absoluë; bien loin d'être une proprieté ou accidentalité opposée à la substance, il sera plus subsistant que les substances. Dieu ne le sauroit détruire, ni même changer en rien. Il est non seulement immense dans le tout, mais encore immuable et éternel en chaque partie. Il y aura une infinité de choses éternelles hors de Dieu (60).

Leibniz is right, of course. Attributes and properties are not independent entities; they need support; they do not float in the world free and unattached like the grin of the Cheshire cat; they are attributes and properties of something, that is, of a *substance*. They cannot be attributes or properties of *nothing*. He is also right in pointing out that absolute (Newtonian) space would be an abso-

(58) Third reply, § 3. The extracts from Clarke's replies are quoted from Clarke's original edition.

(59) *Ibid.* The indivisibility of space was, of course, asserted by More. But also by Spinoza for extension as an attribute of God, and by Malebranche for the « étendue intelligible ».

(60) Fourth paper, §§ 8, 9, 10; Des Maizeaux, 1720, vol. 1, p. 51.

lute being — it is indeed what Newton and the Newtonians assert : infinity implies necessity and thus eternity. But he is wrong in assuming that it would be an absolute being *hors de Dieu;* or, at least, that the Newtonians would admit it; quite the contrary : for them it is closely connected with God. As he is also wrong in assuming that void space is *nothing;* more exactly, in assuming that the gentlemen whom he combats admit the existence of a really void space, that is, of a space where there is *nothing*. Clarke, therefore, enlightens him (61) :

8. *Space* void of Body, is the Property of an *incorporeal* Substance. Space is not *Bounded* by *Bodies*, but exists equally *within* and *without* Bodies. *Space* is not *inclosed between* Bodies; but Bodies, existing in unbounded Space, are, *themselves only*, terminated by their own Dimensions.

9. Void Space is not an *Attribute without a Subject;* because, by *void Space*, we never mean *Space void of every thing*, but void of *Body* only. In All void *Space, God* is *certainly* present, and *possibly* many *other* Substances which are not Matter; being neither *Tangible*, nor Objects of Any of *Our* Senses.

10. *Space* is not a *Substance*, but a *Property;* And if it be a *Property* of That which is necessary, it will consequently (as all *other* Properties of That which is necessary must do,) exist *more necessarily*, (though it be not *itself* a Substance,) than those *Substances Themselves* which are *not necessary*. Space is *immense*, and *immutable*, and *eternal;* and so also is *Duration*. Yet it does not at all from hence follow, that any thing is eternal *hors de Dieu*. For *Space* and *Duration* are not *hors de Dieu*, but are *caused by*, and are *immediate and necessary Consequences of* his Existence. And *without* them, his *Eternity* and *Ubiquity* [or *Omnipresence*] would be taken away.

As for the divisibility of space that Leibniz persisted in opposing to the unity and indivisibility of God, Clarke replies that he has already explained (III.3) that Space is not divisible as it has no parts (62) :

11, *and* 12... In what sense Space *has* or *has not Parts*, has been explained before, *Reply* 3d, § 3. *Parts*, in the *corporeal* Sense of the Word, are *separable, compounded, ununited, independent on, and moveable from, each other :* But infinite Space, though it may by Us be *partially apprehended*, that is, may in our Imagination be conceived

(61) Fourth reply, §§ 8, 9, 10. The words « or *Omnipresence* » are printed within square brackets by Clarke.
(62) *Ibid.*, §§ 11 and 12. Again, the expression within square brackets is found in Clarke.

as composed of *Parts;* yet Those *Parts* (*improperly* so called) being *essentially indiscerpible* and *immoveable* from each other, and not *partable* without an express Contradiction in Terms [*See above, Reply* II § 4; and *Reply* III § 3]; *Space* consequently is in itself *essentially One*, and *absolutely indivisible*.

Clarke's presentation of Newton's conception of space is obviously quite correct (which is hardly surprising). Clarke carefully maintains its fundamental ambiguity and also carefully avoids the use of the term « attribute », a term which Leibniz equates to « property » or « quality », which are the terms he uses himself, though Clarke never rebukes Leibniz for doing so (63). On the other hand, and this, too, is rather curious, by admitting the (possible) presence in space of « other substances » — besides God and matter — and by using the term « indiscerpible », he, so to say, revealed the relation of the Newtonian conception of Space to that of More, about which Newton preferred to keep silent (64).

Needless to say, Clarke's reply did not satisfy Leibniz; he answers therefore (65) :

J'avois objecté que l'Espace pris pour quelque chose de réel & d'absolu sans les Corps, seroit une chose éternelle, impassible, indépendante de Dieu; on a tâché d'éluder cette difficulté en disant que l'Espace est une propriété de Dieu. J'ai opposé à cela dans mon écrit précedent, que la propriété de Dieu est l'Immensité; mais que l'Espace, qui est souvent commensuré avec les Corps & l'Immensité de Dieu, n'est pas la même chose.

J'ai encore objecté, si l'Espace est une propriété, et si l'Espace Infini est l'Immensité de Dieu, que l'Espace fini sera l'Etendüe ou la mensurabilité de quelque chose finie...

Furthermore, if « L'Espace infini est une propriété de Dieu... l'Espace entre dans l'Essence de Dieu », and if (§ 44) « l'Espace infini est l'Immensité de Dieu... il faudra... dire que ce qui est

(63) In Clarke's edition, the translator — de la Roche — followed Leibniz's example. Thus, where Clarke wrote « *space* is not a *Substance*, but a *Property* », de la Roche translated this as : « *L'Espace* n'est pas une *Substance*, mais un *Attribut*. »
(64) In their editions of the *Correspondence*, H. G. Alexander (p. 48) and A. Robinet (p. 110) print *indiscernible* instead of *indiscerpible*. We think that this is a miscorrection, since for Clarke the parts of Space are certainly « discernible » by God; moreover « indiscernible » associated with « not partable » and « indivisible » does not make sense (§ 11 & 12).
On this topic, see Appendix Four, below.
(65) Fifth paper, §§ 36, 37.

dans l'Espace, est dans l'Immensité de Dieu, & par conséquent dans son Essence... » (66). But what about God's Omnipresence? « L'immensité de Dieu, fait que Dieu est dans tous les Espaces. Mais si Dieu est dans l'Espace, comment peut-on dire que l'Espace est en Dieu, ou qu'il est sa propriété? On a bien ouï dire que la propriété soit dans le Sujet; mais on n'a jamais ouï dire que le Sujet soit dans sa Propriété. » One sees how metaphysically absurd are the « réalisation » of Space and the attempts to connect it with God. « Void space » is a void concept; or even not a concept but a void and unclear imagination, one that can be genetically or psychologically explained (67), but not accepted as valid. And if the Newtonians reply that their « void space » is not really « void », that is, void of everything, but only void of matter, they do not improve their position. Indeed :

> J'ai encore demandé, si l'Espace est une propriété, de quelle chose sera donc la propriété un Espace vuide borné, tel qu'on s'imagine dans le Récipient épuisé d'air? Il ne paroit pas raisonnable de dire, que cet Espace vuide, rond ou quarré, soit une propriété de Dieu. Sera-ce donc peut être la propriété de quelque Substances immatérielles, étendues, imaginaires, qu'on se figure (ce semble) dans les Espaces imaginaires? (68)...
>
> Au reste, si l'Espace vuide de Corps (qu'on s'imagine) n'est pas vuide tout à fait, de quoi est-il donc plein? Y a-t-il peut être des Esprits étendus, ou des Substances immatérielles capables de s'étendre et de se resserrer, qui s'y promènent et qui se pénètrent sans s'incommoder, comme les ombres de deux corps se pénétrent sur la surface d'une muraille? Je vois revenir les plaisantes imaginations de feu M. Henry More (homme savant & bien intentionné d'ailleurs), et de quelques autres, qui ont crû que ces Esprits se peuvent rendre impénétrables quand bon leur semble... » (69).

Leibniz, once more, is right and wrong at the same time. He is right in pointing out that, if you take the terms « property », « quality », « substance », and so on, in their traditional meaning and apply them *univoce* to finite and infinite substances, then finite space will be as much a property of a finite body as infinite space is a property of God; and that if we define omnipresence by the property of being everywhere, we make it dependent on space that

(66) *Ibid.*, §§ 42, 44, 45.
(67) Leibniz — following the lead of Descartes — does so in § 47 of his paper.
(68) *Ibid.*, § 38.
(69) *Ibid.*, § 48. See, above, note 57.

cannot *vice versa* be itself made dependent on God. But the Newtonians do not admit this; for them the relation of the finite extension of a body to that body is something quite different from the relation of Space to God; and even something quite different from the relation of the body to the space in which it is located.

As a matter of fact, Newton's conception of Space cannot be fitted into the traditional ontology — nor, to tell the truth, can that of Leibniz — which they both accept as a common basis of discussion. The Newtonian conception of space, boundless expansion and exteriorization of God's infinite essence and power, would, as a matter of fact, be much better characterized by the term « attribute », as was done by More and Spinoza, than by the terms « property » and « quality » used by Clarke. But, of course, Clarke cannot use « attribute » (70) and has to fall back upon Newton's own formulation (in the *Scholium Generale*) according to which God by existing always and everywhere *constitutes* duration and space. Thus, in his fifth reply, passing over Leibniz's hints at the connection between the Newtonian conception of Space and that of Henry More, but not passing over his accusation of confounding Space with God's immensity and putting it thus into the *essence* of God, Clarke restates his (Newton's) position (71) :

> The *Space occupied by a Body*, is not the *Extension of the Body;* but the *extended Body* exists *in* that *Space*.
>
> There is no such Thing in reality, as *bounded Space;* but only we in our Imagination *fix our Attention* upon what *Part* or *Quantity* we please, of that which it self is always and necessarily *unbounded*.
>
> *Space* is not an *Affection* of *one Body*, or of *another* Body, or of *any finite Being;* nor *passes from Subject to Subject;* but is always *invariably* the *Immensity* of *one only* and *always the same* Immensum.
>
> *Finite Spaces* are not at all the *Affections of Finite Substances;* but they are only *those Parts* of *Infinite* Space, *in which* Finite Substances exist.
>
> If Matter was *infinite*, yet *infinite Space* would no more be an *Affection* of that *infinite Body*, than *finite Spaces* are the *Affections* of *finite Bodies;* but, in that Case, the *infinite Matter* would be, as finite Bodies now are, *in* the *infinite Space*.
>
> *Immensity*, as well as Eternity, is *essential* to God. The *Parts* of *Immensity* (being totally of a different kind from *corporeal, partable,*

(70) It is too strongly linked with Spinoza. Thus, already in his *Demonstratio* he has used the less objectionable term *modus;* cf. *supra*, n. 54.
(71) Fifth Reply, §§ 36-45.

separable, divisible, moveable Parts, which are the ground of *Corruptibility*); do no more hinder *Immensity* from being essentially One, than the *Parts* of *Duration* hinder Eternity from being essentially One.

God himself suffers *no Change* at all, by the *Variety* and *Changeableness* of Things which *live and move and have their Being in him.*

This *strange* Doctrine, is the express Assertion of St. *Paul*, as well as the plain Voice of *Nature and Reason.*

God does not exist *In* Space, and *In* Time; but *His Existence causes Space and Time.* And when, according to the *Analogy* of *vulgar Speech*, we say that he exists *in All Space* and *in All Time;* the Words mean only that he is *Omnipresent* and *Eternal*, that is, that *Boundless Space and Time* are necessary *Consequences* of his Existence; and not, that Space and Time are Beings distinct from him, and IN *which* he exists. [Moreover (72)] :

To say that *Immensity* does not signify *Boundless Space*, and that *Eternity* does not signify *Duration* or *Time without Beginning and End*, is (I think) affirming that *Words* have no *meaning.*

This *fifth* reply (of 29 Oct. 1716) was the last of the papers exchanged by the two protagonists. Leibniz's death (14 Nov. 1716) put a premature end to the polemics. Clarke, thereupon, published in 1717 the bilingual edition, which presented *face à face* the original texts of his and Leibniz's papers and their translation, respectively, into French and English. It made quite a stir, though, to tell the truth, more on the Continent than in England (73). Thus in 1720 Des Maizeaux reprinted it (in Amsterdam), leaving out the English text, although he was living in England. In his preface he discussed the invention of the infinitesimal calculus, taking the part of Newton against Leibniz.

It is well known that Newton helped Des Maizeaux in preparing his edition and especially this report (74). It is not improbable that, on this occasion, Newton re-read the text of the polemics and realized the danger of « misinterpretation » implied by the, indeed, somewhat loose and imprudent way in which Dr. Clarke had used

(72) *Ibid.*, § 106.

(73) On the continent, the *Correspondence* was quickly translated into German and published in 1720, the same year as Des Maizeaux's *Recueil.* In the eighteenth century Des Maizeaux's French edition of the *Correspondence* was printed thrice (1720, 1740, 1759), and there were two other printings in French (1768, 1789); the German edition was printed twice (1720, 1740) and a Latin version was published in Holland in 1740. The only printings in English during the eighteenth century were Clarke's original bilingual edition (1717) and the reprint of it in the 1738 edition of Clarke's *Works.*

(74) See, below, Appendix Three.

such terms as « quality », « property », and so on. It is also possible, of course, that Des Maizeaux himself had drawn Newton's attention to it. Yet be that as it may, the fact remains that Newton used the opportunity (of the Des Maizeaux edition) for the publication of an *Avertissement au Lecteur*, which instructed the reader not to take these terms *verbatim* as Leibniz had wilfully done. Des Maizeaux did not print Newton's *Avertissement au Lecteur* separately, but — as we have seen (75) — merely quoted from it in his own *Preface.* The reader — our reader — may object : did not Des Maizeaux expressly state :

> Cependant, comme les termes de Qualité ou de *Proprieté*, ont d'ordinaire un sens different de celui dans lequel il les faut prendre ici : M. Clarke a souhaité que j'avertisse ses Lecteurs, que « lorsqu'il parle de *l'Espace infini* ou de *l'Immensité*, & de la *Durée infinie* ou de *l'Eternité;* & qu'il leur donne, par une imperfection inévitable de language, le nom de *Qualitez* ou de Proprietez de la Substance qui est immense, ou éternelle; il ne prétend pas prendre le terme de *qualité* ou de *proprieté*, dans le même sens que le prennent ordinairement ceux qui traitent de la Logique, & de la Metaphysique lors qu'ils les appliquent à la Matière ».

Why then do we attribute this statement to Newton rather than to Clarke? For the simple reason that it was written by Newton and not by Clarke, who had at most only rewritten or revised it before giving it — in English or in a French translation to Des Maizeaux. It may be observed that in this portion of Newton's *Avertissement au Lecteur* printed by Des Maizeaux the terms « quality » and « property » are literally and correctly rendered by « qualité » and « propriété ». But in the text which follows, Des Maizeaux merely used De La Roche's previous version, so that the *Avertissement* was not applicable since these terms are not used at all, being rendered by « attribut » (76).

Indeed, among Newton's manuscripts in the Portsmouth Collection (Cambridge University Library) we have found two sheets that bear the superscript : *Avertissement au Lecteur* and contain three drafts of this *Avertissement.* Two others, belonging to a private collection, have been kindly copied for us by Dr. D. T. Whiteside from a photostat and are printed below as Drafts A and B.

(75) Page 81-84 *supra.*

(76) See note 63 *supra.*

It is difficult to tell in what order these texts were written. Most probably Newton started with a rather short text, then enlarged it until it became a rather long exposition of his views upon space and its relation to God. Then, realizing that it had got out of hand and had outgrown the dimensions of an *Avertissement*, he reshortened it, leaving out things which were better left unsaid — e.g., the reference to the MAKOM that clearly established the relation of his conceptions much less to that of the « ancient Hebrew's » than to those of Raphson and More (77).

The different versions of the *Avertissement* are somewhat repetitious, which is natural for preliminary drafts of the same text. Yet since they give us some interesting glimpses of Newton's mind, and offer a good example of his working procedures, we print all of them.

(In the following transcriptions, once again, material within these symbols [— *i*] ... [+ *i*] has been inserted by Newton. Such symbols as [*], [**], [***] refer to comments printed immediately after the text.)

Draft A

Avertissement au Lecteur

The Reader is desired to observe that wherever in the following papers, through unavoidable narrowness of language, infinite space or Immensity & endless Duration or eternity, are spoken of as Qualities or Properties of the Substance wch is Immense or Eternal, the terms Quality & Property are not to be taken in that sense wherein they are vulgarly, by the writers of *Logick & Metaphysicks* applied to *matter;* but in such a sense as only implies them to be CONSEQUENTS of the Existence of a Being which is really necessarily & substantially Omnipresent & Eternal. *See* Dr Clarks *4th Reply,* § *10.*

Avertissement au Lecteur

Draft B

The Reader is desired to observe, that wherever in the following papers through unavoidable narrowness of language, infinite space or Immensity & endless duration or Eternity, are spoken of as *Qualities* or *Properties* of the substance wch is Immense or Eternal, the terms *Quality & Properly* are not taken in that sense wherein they are vulgarly, by the writers of *Logick & Metaphysicks* applied to *matter;* but

(77) See notes 53 and 55 *supra* for the use of MAKOM by Raphson and More.

in such a sense as only implies them to be modes of existence in all beings, & unbounded [— *i*] *modes* & [+ *i*] consequences of the existence of a substance which is really necessarily & substantially Omnipresent & Eternal : Which existence is neither a substance nor a quality, but the existence of a substance with all its attributes properties & qualities, & yet is so modified by place & duration that those modes cannot be rejected without rejecting the existence. [*] When we speak of things wch come not within the reach of our senses, it's difficult to speak without Tropes & Figures [*a*]. In this sense the Schoolmen made a *Nunc stans* to be eternity, [— *i*] & [+ *i*] [*b*] [— *i*] by consequence [+ *i*] [*c*] [— *i*] an attribute of God [+ *i*] & eternal duration hath [*d*] [— *i*] a better [+ *i*] title to that name, tho it be but a mode of his existence. For a *nunc stans* is a moment wch always is & yet never was nor will be : which is a contradiction in terms. [**] And it is as much a contradiction to tell us that God is every where by his vertue & no where by his substance, & yet some make this to be his Ubiquity & by consequence one of his Attributes.

[*a*] : & danger of being misunderstood *crossed out.* [*b*] : that is *crossed out.* [*c*] : one of God's attributes *crossed out.* [*d*] : as good a *crossed out.*

Comments on Draft B

[*] As we have already pointed out, Newton has never called Space an Attribute of God, though in his *De Gravitatione et Æquipondio Fluidorum* (cf. A. R. Hall and Marie Boas Hall, *Unpublished Scientific Papers of Isaac Newton : a Selection from the Portsmouth Collection,* Cambridge University Library, Cambridge, 1962, pp. 99, 103) he tells us that *all* beings are extended and that extension belongs to being as such, and that therefore not only material substance, but also spiritual ones, that is minds and even God, are extended. But there he did not use the term *modus.* He used *affectio* (cf. *supra,* p. 88, n. 56). It may be that he borrowed *modes* from Clarke, cf. *supra,* p. 87, n. 54).

[**] Newton's God is not *eternal* in the traditional sense of the word, that is, he is not above time — a mobile image of the immovable eternity — but *sempiternal.* In the unpublished drafts of the *Scholium Generale* (A. R. Hall and Marie Boas Hall, *op. cit.,* p. 357) Newton says, « Æternus est et Infinitus seu durat ab æterno in æternum & adest ab infinito in infinitum. Duratio ejus non est nunc stans sine duratione, neque præsentia ejus est nusquam. » In the published version of the *General Scholium,* Newton did not

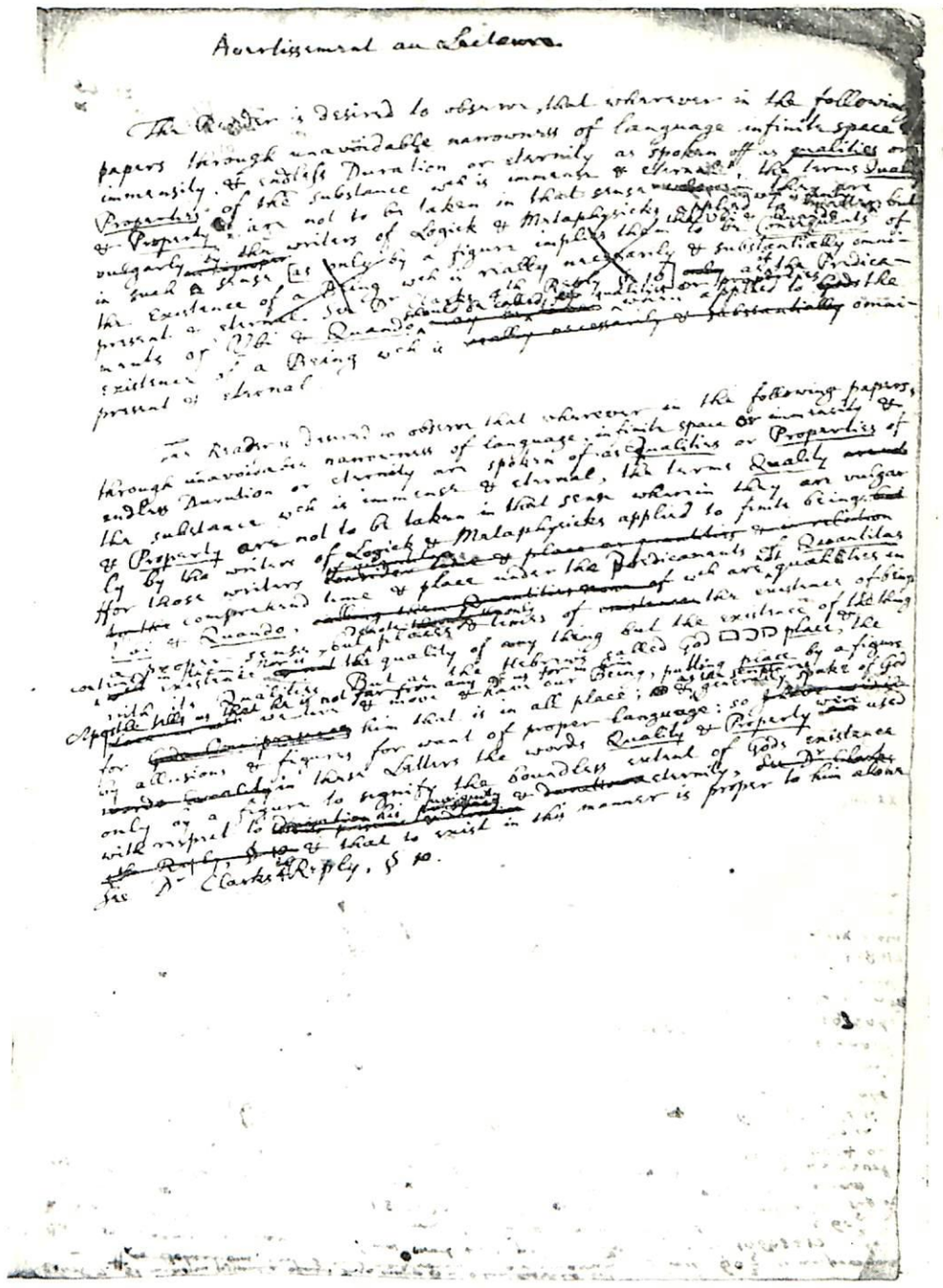
mention the *nunc stans*. It is interesting that Clarke, though quoting the famous Boethian definition of eternity, *innumerabilis vitæ simul tota et perfecta possessio,* also rejected the conception of timeless, or supra-temporal eternity; Clarke, however, does not mention expressly either Boethius or the *nunc stans;* cf. S. Clarke, *A Demonstration of the Being and Attributes of God,* prop. V (p. 42) : « Of the manner of our conceiving the Eternity of God... It is, in the most proper and Intelligible Sense of the Words, to all the purposes of Excellency and Perfection *Interminabilis vitæ tota simul et perfecta Possessio* : the *Entire and Perfect Possession of an endless life*... Others have supposed that the Difference between the Manner of the Eternal Existence of the Supreme Cause and that of the Existence of Created Beings, is this : That, whereas the latter is a continual transient *Succession* or Duration; the former is *one Point* or *Instant* comprehending Eternity and wherein all Things are really co-existent... the *Schoolmen* have indeed generally chosen to defend it... on the other hand, there are many Learned Men, of far better Understanding and Judgment, who have resisted and opposed it. » As such « Learned Men » Clarke quotes Gassendi : « Lusus merus non intellectorum verborum, *Physic. lib.* I », and Archbishop Tillotson. vol. VII, Serm. 13, and vol. VI, Serm. 6.

Draft C (C. U. L., Portsmouth Coll., Add. 3965, fol. 289)

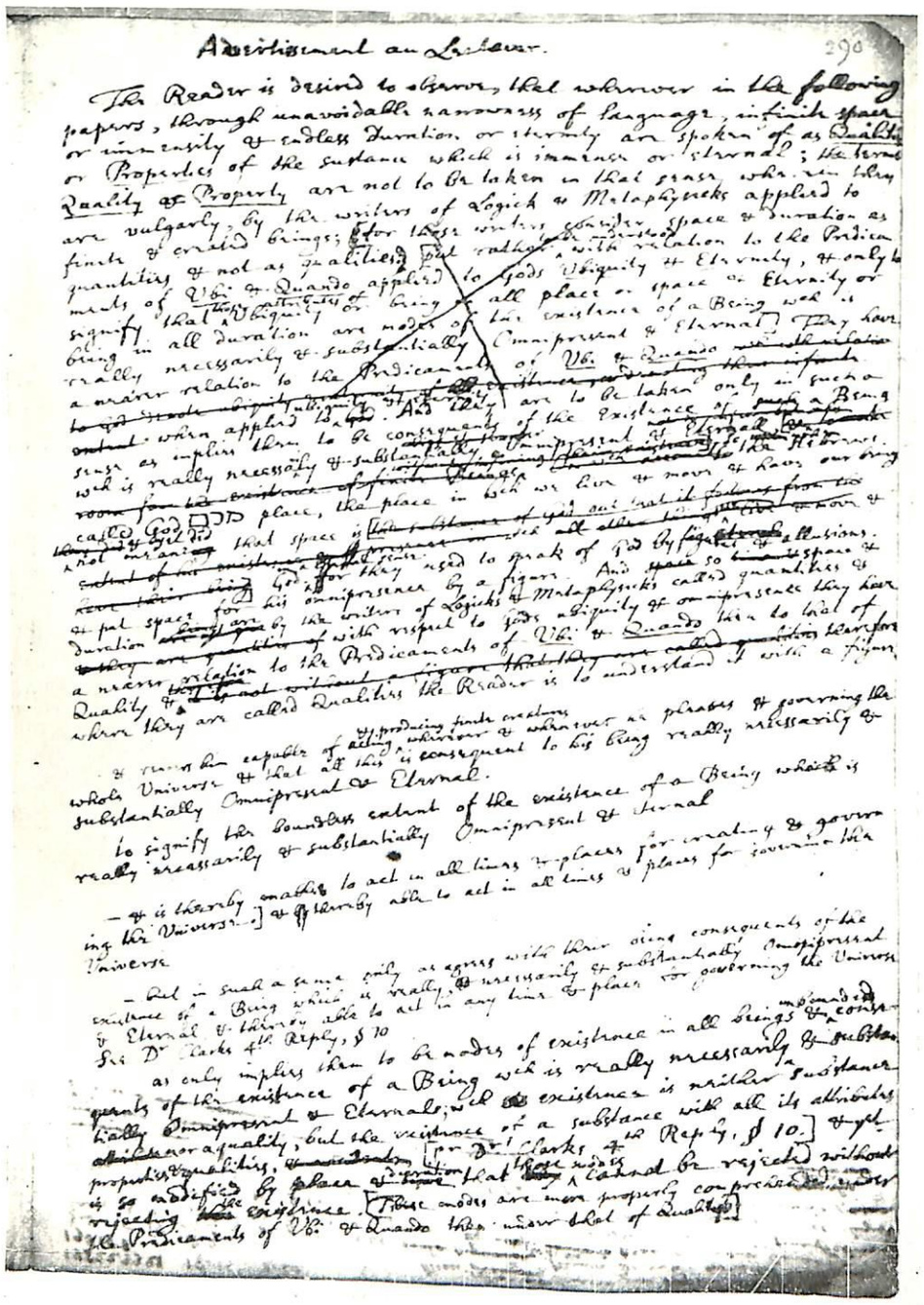
Avertissement au Lecteur

The Reader is desired to observe, that wherever in the following papers through unavoidable narrowness of language infinite space or immensity, & endless Duration or eternity as spoken off as *qualities* or *Properties* of the substance w^ch^ is immense & eternal, the terms *Quality* & *Property,* are not to be taken in that sense wherein they are vulgarly by the writers of Logick & Metaphysicks applied to matter [— *i*] w^ch^ is finite [+ *i*] : but in such [*a*] sense [*b*] as [— *i*] if [+ *i*] the Predicaments of *Ubi* & *Quando* [*] [*c*] [— *i*] should be called [*d*] qualities or properties [+ *i*] when applied to [*e*] the existence of a Being w^ch^ is [*f*] omnipresent & eternal.

[*a*] : a *crossed out, replaced by* an improper *which was then crossed out.* [*b*] : as only by a figure implies them [— *i*] the Ubi & Quando [+ *i*] to be CONSEQUENTS of the Existence of a Being w^ch^ is really necessarily of the Existence of a Being w^ch^ is really necessarily & substantially omnipresent & eternal. See D^r^ Clarks 4^th^ Reply § 10 *has been enclosed within square brackets and crossed out. The next word* only *has been crossed out.* [*c*] : may be taken *crossed out.* [*d*] : for *crossed out.* [*e*] : Gods *crossed out.* [*f*] : really necessarily & substantially *crossed out.*



Drafts C & D, C.U.L., Add. 3965, fol. 289



Draft E. C.U.L., Add. 3965, fol. 290

Comment on Draft C

[*] The « predicaments » *ubi & quando* are the Aristotelian categories ποῦ and πότε. Newton wants us to understand that by characterizing God as immense and eternal we do not ascribe to him a « property » or a « quality » but only give answers to the questions : where? (*ubi*), namely « everywhere », and when? (*quando*), namely, « always », in the same sense in which, speaking about a finite being, we would say : « here » or « there », and « today » or « last year ».

Draft D (C.U.L., Add. 3965, fol. 289)

The Reader is desired to observe that wherever in the following papers, through unavoidable narrowness of language, infinite space or immensity & endless Duration or eternity are spoken of as *Qualities* or *Properties* of the substance w^ch^ is immense & eternal, the terms *Quality* [*a*] & *Property* are not to be taken in that sense wherein they are vulgarly by the writers of Logick & Metaphysicks applied to finite beings. ffor those writers [*b*] [*c*] comprehend time & place under the Predicaments of *Quantitas Ubi* & *Quando*, [*d*] w^ch^ are [— *i*] not [+ *i*] qualities in a proper sense, but [— *i*] denote [*e*] only [+ *i*] places & times of [*f*] the existence of beings [— *i*] conteined in them : Nor is [+ *i*] [*g*] existence [*h*] the quality of any thing but the existence of the thing with its Qualities. But as the Hebrews called God *MAKOM* *place* [— *i*] & [+ *i*] the [*j*] [— *i*] Apostle tells us that he is not far from any of us for in him [+ *i*] we live & move & have our Being, [*] putting *place* by a figure for [*k*] him that is in all place; and [— *i*] as the scriptures [+ *i*] generally spake of God by allusions & figures for want of proper language : so [*l*] in these Letters the words Quality & Property [*m*] [— *i*] were [+ *i*] used only by a figure to signify the boundless extent of Gods existence with respect to [*n*] his [*o*] [— *i*] ubiquity [+ *i*] & [*p*] eternity, [*q*] & that to exist in this manner is proper to him alone. See D^r^ Clarks 4^th^ Reply, § 10.

[*a*] : Are not *crossed out*. [*b*] : consider time & place as quantities & in relation to the *crossed out*. [*c*] : of quantitas *inserted and crossed out*. [*d*] : calling them Quantities... *crossed out*. [*e*] : the only *crossed out, followed by* the *which was then crossed out*. [*f*] : existence crossed out. [*g*] : w^ch^ *crossed out*. [*h*] : is not *crossed out*. [*j*] : place in w^ch^ *crossed out*. [*k*] : Gods Omnipresence *crossed out*. [*l*] : I have used the words Quality *crossed out*. [*m*] : are *crossed out*. [*n*] : duration *crossed out; something written under the line not fully legible, ending* presence & duration, *then crossed out*. [*o*] : presence crossed out. [*p*] : duration *crossed out*. [*q*] : See D^r^ Clarks 4^th^ Reply § 10 *crossed out*.

* The word *MAKOM* is written by Newton in Hebrew characters.

Comment on Draft D

[*] It is impossible to tell whether this reference to the « Hebrews » (the Cabalists) who called God MAKOM is based on Newton's direct knowledge of the Cabala. It could have been, as a copy of Knorr von Rosenroth's *Kabbala denudata seu doctrina Hebræorum transcendentalis et metaphysica* (printed in Sulzbach in 1677) was in Newton's library. It seems however more probable, that Newton borrowed the term from Henry More (cf. *supra*, n. 53 and n. 55) who indeed had a first-hand knowledge of it (cf. Gershom Scholem, *Bibliographia Kabbalistica*, Leipzig : W. Drugulin, 1927).

On the Cabala's concept of space and its role, cf. Max Jammer, *Concepts of Space* (Cambridge : Harvard Univ. Press, 1954) and Markus Fierz, « Über d. Ursprung u. d. Bedeutung d. Lehre Isaac Newtons v. absoluten Raum », *Gesnerus*, 1954, *11* : 62-120. It seems to us, however, that one must not exaggerate the *real* influence of the Cabala on later thinkers, even on More or Raphson, not to speak to Newton, since the characteristic teaching of the Cabalist, that of the *zimzum*, that is, the « retreat » of God into himself in order to leave place for the world, is conspicuously absent in their teachings. The mention of the MAKOM (like the reference to the « Phœnicians » in the *Opticks*, query XXVIII) is the result of the belief — or wish to believe — in the antiquity, and thus the « respectability », of certain major conceptions.

There is no doubt that Newton was convinced *a*) that the « ancients » had already conceived the doctrine of absolute space and universal gravitation and *b*) that by showing it he increased the acceptability of his own theory. Indeed he not only told this to Gregory (cf. the comment to Draft E, below) appealing to the authority of the ancient philosophers of Greece and Phoenicia, but he also wrote a very interesting sketch of their conceptions, which he gave to Gregory, who, partially and under his own name, published it in the introduction to his *Astronomiæ Physicæ & Geometricæ Elementa*, Oxoniæ, 1702. Characteristically enough, the MAKOM, present in the MS, disappeared in the printed version.

The Hebrew word MAKOM occurs also in one of the drafts made by Newton, while preparing the second edition of the *Principia*, in which he was expounding some of the thoughts which appear in the General Scholium written to conclude that second

edition. (This draft, MS Add. 3965.13, is being edited by us for publication with other similar documents.)

There Newton wrote, in part :

« Judæos Deum rectius *MAKOM* locum vocasse, id est substantiam locis omnibus essentialem in quo (ut loquitur Apostolus) locamur et vivimus et movemur et sumus... » [The word *MAKOM* is written by Newton in Hebrew].

Draft E (C. U. L., Add. 3965, fol. 290)

Avertissement [*a*] au Lecteur

The Reader is desired to observe, that wherever in the following papers, through unavoidable narrowness of language, infinite space or immensity & endless duration or eternity are spoken of as *Qualities* or *Properties* of the sustance [*l*] which is immense or eternal; the terms *Quality* & [*b*] *Property* are not to be taken in that sense wherein they are vulgarly, by the writers of Logick & Metaphysicks applied to [*] finite & created beings; [*c*] for those writers consider space & duration as quantities & not as qualities. [*d*] [*e*] They have a nearer relation to the Predicaments of *Ubi & Quando* [*f*] when applied to [*g*] [— *i*] ubiquity & Eternity [+ *i*]. [*h*] And they are to be taken only in such a sense as implies them to be consequents of the Existence of [*j*] a Being wch is really necessarily [*k*] & substantially [*l*] Omnipresent & Eternall, [*m*] [*n*] [— *i*] So [*o*] when [+ *i*] the Hebrews called God MAKOM place, the place in wch we live & move & have our being [*p*] [— *i*] & yet did [+ *i*] not mean [*q*] that space is [*r*] God [— *i*] in a literal sense. [+ *i*] ffor they used to speak of God by figures [*s*] & allusions & put space for his omnipresence by a figure. And [*t*] so [*u*] space & duration [*v*] [— *i*] are [+ *i*] by the writers of Logicks & Metaphysicks called quantities & [*w*] with respect to Gods ubiquity & omnipresence they have a nearer relation to the Predicaments of *Ubi & Quando* then to that of Quality & [*x*] therefore where they are called Qualities the Reader is to understand it with a figure.

& renders him capable of acting [— *i*] & producing finite creatures [+ *i*] wherever & whenever he pleases & governing the whole Universe & that all this is consequent to his being really necessarily & substantially [**] Omnipresent & Eternal.

to signify the boundless extent of the existence of a Being which is really necessarily & substantially Omnipresent & eternal

— & is thereby [*y*] able to act in all times & places for creating & governing the Universe. > & [*z*] thereby able to act in all times & places for governing the Universe

— but in such a sence only as agrees with their being consequents of the existence of a Being which is really, [*aa*] necessarily & substantially Omnipresent & Eternal & thereby able to act in any time & place for governing the Universe See Dr Clarks 4th Reply, § 10

as only implies them to be modes of existence [***] in all beings & [— *i*] unbounded [+ *i*] consequents of the existence of a Being wch is really necessarily & substantially Omnipresent & Eternal; wch [*bb*] existence is neither [— *i*] a [+ *i*] substance [*cc*] nor a quality, but the existence of a substance with all its attributes properties & qualities, [*dd*] < pr Dr Clarks 4th Reply, § 10. > & yet is so modified by place & [*ee*] [— *i*] duration [+ *i*] that [*ff*] [— *i*] those modes [+ *i*] cannot be rejected without rejecting [*gg*] [— *i*] the [+ *i*] existence.

< These modes are more properly comprehended under the Predicaments of Ubi & Quando then under that of Quality. [*hh*]. >

[*a*] : *Originally* Ad.... [*b*] : & *written over* or. [*c*] : *An opening square bracket has been inserted here and apparently crossed out.* [*d*] : *A closing square bracket has been inserted here and apparently crossed out, as if Newton had at first intended that the matter between* [*c*] *and* [*d*] *was to be rejected, and had then changed his mind.* [*e*] : *The following conclusion was apparently at first written to replace the matter between* [*c*] *and* [*d*], *was then enclosed in square brackets, and crossed out by a pair of intersecting lines* but rather [— *i*] to be understood [+ *i*] with relation to the Predicaments of *Ubi* & *Quando* applied to Gods *Ubiquity & Eternity*, & only to signify that [— *i*] those attributes of [+ *i*] Ubiquity or being in all place or space & Eternity or being in all duration are modes of the existence of a Being wch is really necessarily & substantially Omnipresent & Eternal. [*f*] : They have a nearer relation to the Predicaments of *Ubi & Quando* wch wth relation to God denote ubiquity & eternity of his [? — *crossed out*] existence, n[?— *crossed out*] denoting their infinite extent. *crossed out.* [*g*] : God *crossed out.* [*h*] : *The diagonal lines cross out not only the matter enclosed by Newton within square brackets, contained in note* [*e*] *above, but are drawn so as to include more material, possibly up to this point. Very likely, this is merely a result of carelessness in drawing the lines.* [*i*] : such *crossed out.* [*k*] : *originally* necessaly. [*l*] : ubique et semper *inserted and then crossed out.* [*m*] : *The following has been enclosed within square brackets and then crossed out* & [— *i*] not to inferr but only [+ *i*] to make room for the existence of finite Beings [— *i*] without inferring their existence [+ *i*] ⊙ [*n*] : On wch account so *crossed out.* [*o*] : *an unreadable word crossed out.* [*p*] : they did *inserted and crossed out.* [*q*] : *Originally* meaning. [*r*] : *The following has been enclosed within square brackets and crossed out* the substance of God but that it follows from the extent of his existence & of [?] presence in wch all other things wch [?] live & move & have their being. [*s*] : Eternal *crossed out.* [*t*] : space *crossed out.* [*u*] : time & *crossed out.* [*v*] : are not qua... *crossed out,* being *inserted and then crossed out.* [*w*] : & they are not quantities of *crossed out.* [*x*] : It is not without a figure that they are called quantities *crossed out,* therefore *inserted and then crossed out.* [*y*] : enabled [?] *altered to* able. [*z*] : *a single letter crossed out.* [*aa*] : & *crossed out.* [*bb*] : as *or* its *crossed out.* [*cc*] : attribute *crossed out.* [*dd*] : & accidents *crossed out* ⊙ [*ee*] : time *crossed out.* [*ff*] : they *crossed out.* [*gg*] : the *or this* [?] *crossed out.* [*hh*] : *Maybe* Quality *altered from* Qualities.

Comments on Draft E

[*] It is interesting to note that in Drafts A and B Newton says *matter;* in Draft C *matter which is finite;* in Draft D *finite beings;* and here in Draft E *finite and created beings.* The printed text has *Matière.*

[**] Newton's God is omnipresent *per substantiam* and not only *per virtutem* because action cannot be separated from substantial presence and thus nothing and nobody can act where it — or he — is not. Thus in the *Scholium Generale* at the end of Bk. III of the *Principia* (1713), Newton wrote : « Omnipræsens est non per *virtutem* solam, sed etiam per *substantiam :* nam virtus sine substantiâ subsistere non potest »; translated by Andrew Motte, « He is omnipresent not *virtually* only, but also *substantially;* for virtue cannot subsist without substance. » Cf. *David Gregory, Isaac Newton and their Circle. Extracts from David Gregory's Memoranda 1677-1708,* edited by W. G. Hiscock (Oxford : printed for the editor, 1937), pp. 29-30 :

21 December, 1705. Sir Isaac Newton was with me and told me that he had put 7 pages of Addenda to his book of Light & Colours in this new Latin edition of it. He has by way of quære explained the explosion of Gun powder, all the chief Operations of Chymistry. He has shewed that Light is neither a communication of motion nor of a Pressure. He inclines to believe it to be projected minute bodys. He has explained in those Quærys the double Refraction in Iseland Christall. His Doubt was whether he should put the last Quære thus. *What the space that is empty of body is filled with.* The plain truth is, that he believes God to be omnipresent in the literal sense; And that as we are sensible of Objects when their Images are brought home within the brain, so God must be sensible of every thing, being intimately present with every thing : for he supposes that as God is present in space where there is no body, he is present in space where a body is also present. But if this way of proposing this his notion be too bold, he thinks of doing it thus. *What Cause did the Ancients assign of Gravity.* He believes that they reckoned God the Cause of it, nothing els, that is no body being the cause; since every body is heavy.

[***] Cf. *supra,* p. 87, n. 54, for Clarke's use of the term *modes.*

APPENDIX ONE

Drafts of Newton's Letter to Conti

Anyone who studies Newton's MSS rapidly become aware of the many drafts, versions, and even *verbatim et litteratim* copies, that Newton made of letters and other documents. For the letter to Conti, dated London, 26 February 1716 (O. S.), there are collected together in the Portsmouth Collection (1) eight separate and distinct drafts of this letter (2). Of these only one, Draft No. 4, bears the address of the sender and the date (« Leicester ffields. London, 26 Feb. 1715/6 »), all of the others merely beginning « S^r^ »; furthermore, this is the only one of the drafts to end with a salutation and a signature (« I am, S^r^, Yo^r^ most humble and most obedient Servant, Is. Newton »). This is the draft from which the copy sent to Conti was made; this copy, however, contains some matter — crossed out — not available in the printed versions. We have printed below some extracts from these drafts to show the reader Newton's method of work. Drafts Nos. 1, 5, 6, and 8 do not contain any reference to the strictures of Leibniz against the Newtonian philosophy. Draft No. 2 has the barest reference to the philosophical debate. Drafts Nos. 3 & 4 devote some space to the debate on philosophy, whereas in Draft No. 7, the philosophical questions are discussed at some length.

In Draft No. 1, Newton refers to himself throughout as « M^r^ Newton », but in Drafts 2, 3, 4, 6, 7, 8 he uses the first person. In Draft No. 5, however, the first paragraph began the letter in the first person (« I thank you for shewing me... »), but the second paragrah was written out in the third person (« M^r^ Newton gave an Example of the method of fluxions in his Analysis... ») which Newton then changed to the first person (« I gave an Example of

(1) These are all collected together in a part of C.U.L. MSS Add. 3968, « Papers relating to the dispute respecting the invention of fluxions », no. 38: « Letter of Newton to the Abbé Conti in reply to the Postscript of Leibnitz to the same. This letter refers to the 1st Postscript given in Des Maizeaux. » See *A catalogue at the Portsmouth Collection of books and papers written by or belonging to Sir Isaac Newton* (Cambridge : at the University Press, 1888), p. 8.

(2) There are three other parts of drafts of this letter which we have found elsewhere in the Portsmouth Collection; yet another has been found by Professor A. Rupert Hall and Professor Marie Boas Hall. See, below, Drafts 9, 10, 11.

the method of fluxions in my Analysis... »). The remainder of the letter was written in the third person (3).

Draft No. 9 is incomplete. The extant portion is similar to Draft No. 7. The penultimate paragraph which we have printed from Draft No. 7, while almost word-for-word identical to the discussion of the two philosophies in Draft No. 9, does contain some significant differences. For instance, in Draft No. 9 Newton says that Leibniz « Seems to mean the the argument of Induction from experiments upon w^ch^ experimental Philosophy is founded is not a demonstration & therefore ought to be rejected », but in Draft No. 7, he says that Leibniz « means that the argument of Induction... is not a good one ». In Draft No. 9, Newton asserts that Leibniz « calls the world God's watch », but this statement is not to be found in Draft No. 7. Draft No. 9 is apparently a « fair copy », but Draft No. 7 is much revised, with many words struck out and others inserted. The paragraph in Draft No. 9 beginning « D^r^ Wallis died in October 1703... » also appears in Draft No. 7, but with many changes (4). But the incomplete first paragraph in the fragment of Draft No. 9, discussing the use of analytic methods in writing the *Principia*, is absent from Draft No. 7, and — although Newton refers to the *Principia* as proof that he knew the calculus before 1687 in Draft No. 3 and in Draft No. 5 (quoting the Marquis de l'Hôpital in the latter) in no other draft does he go into the question of having first done parts of the *Principia* by methods of analysis and then rewriting them by methods of synthesis or composition (« as all things in Geometry ought to be »). Since this particular topic appears in Newton's *Recensio* of the *Commercium* we can well understand how those who ordered Newton MSS and compiled the catalogue put these pages among the MSS of the *Recensio*. Yet the reference by Newton to « the latter part of his [Leibniz's] Postcript » and the discussion thereof must date this document later than Leibniz's letter of 1715, which is the year following the publication of the *Recensio*.

Draft No. 10 exists only as a three-page statement of the phi-

(3) This type of correction, ending up with a mixture of the first and the third person, occurs also in the fragment found by the Professors Hall. Since Draft No. 5 does not contain a discussion of the philosophical questions, to be found in the document found by the Professors Hall, it may be that the two go together — but we must be careful not to surrender to the temptation to substitute hypotheses — however attractive they may be — for certainties.

losophical controversy. It might very well have been part of one of the other drafts that does not any longer have this philosophical discussion.

Drafts Nos. 11 and 12 are known only by a single paragraph each. The similarity between these paragraphs has been discussed above (see pp. 16-17); that they are versions of Newton's letter to Conti is clear by comparison with the others.

Among the drafts of Newton's letter to Conti, there is another letter written by Newton, presumably to Conti. It is most amusing and sheds light on Newton's personality. It reads as follows :

S^r^

[*a*] [— *i*] It requiring some time to write Letters receive answers [+ *i*] & do [*b*] what [— *i*] else [+ *i*] you & I were discou[*r*]sing [*c*] this morning [*d*] [— *i*] before [+ *i*] y^e^ publishing [— *i*] of the Letters [+ *i*] of M^r^ Leibnitz [*e*] I beg the favour to signify to yo^r^ Bookseller that if he pleases to deferr publishing them till Lady next I will give him twelve Guineas [*f*] as a recompense for the loss of his time. I am

Yo^r^ humble Servant
Is. NEWTON.

[*a*] : The writing of Letters *crossed out.* [*b*] : *Originally* doing. [*c*] : about *crossed out and then inserted above the line and finally crossed out again.* [*d*] : in order to *crossed out.* [*e*] : his Letters requiring some time *crossed out.* [*f*] : for *crossed out.*

In the following, the first 8 drafts have been numbered in the sequence in which they are to be found in the MSS. As before, insertions are indicated by [— *i*] --- [+ *i*], and all other alterations are given at the end of each piece. We have used angle brackets <---> where Newton occasionally used square brackets, so as to avoid any confusion with modern editorial usage. Newton most often used square brackets to mark off material to be omitted when the document in question would be copied.

Draft No. 1 [4 pp., fols. 558 r. & v., 559 r. & v.]

A very early draft, with many words and phrases crossed out and others inserted between the lines; begins S^r^; *incomplete; discusses only the question of mathematical priority;* refers to « M^r^ Newton » throughout.

Draft No. 2 [4 pp., fols 560 r. & v., 561 r. & v.]

Another very early draft, with many words and phrases crossed out and others inserted between the lines. Like Draft No. 1, it begins S^r^. *First line of letter, crossed out, reads :* It is now twenty years since I left off Mathematicks, & when I medled not with these matters I was surprised to find myself; *the next line, also crossed out, reads :* It was; *the third attempt, again crossed out, reads :* It is now 20 years since I left off the study of Mathema[*ticks*]. *Then the letter begins once more :* When the R. Society upon a Question arising... *A few lines later the letter begins anew :*

S^r^

[— *i*] You know that [+ *i*] [*a*] the Commercium Epistolicum [*b*] conteins the ancient Letters & Papers [*c*] [— *i*] preserved [+ *i*] in the Archives & Letter Books of the R. S. & Library of Mr. Collins... And the Postscript which you shewed me is of the same kind. [— *i*] For [+ *i*] He tells you in it that the English shall not have the pleasure of seing him return an Answer... & he falls upon my Philosophy, w^ch^ is nothing at all to the question [*d*] & in squabling about it [*e*] corrupts the significations of words calling those things miracles w^ch^ happen constantly [*f*] & those things occult qualities w^ch^ are not occult & at the same time he has sent a Mathematical Probleme to be solved by the English Mathematicians w^ch^ is as little the purpose & contends for Hypotheses in opposition to Propositions proved from experiments & observations and experiments by the argument of Induction, & ascribes opinions to me which are not mine.

[*a*] : When *crossed out and replaced by* Ever since *which was then crossed out.* [*b*] : came abroad *crossed out.* [*c*] : found *crossed out.* [*d*] : *The remainder of the paragraph is much crossed and interlined.* [*e*] : calls those *crossed out.* [*f*] : *something illegible crossed out.*

Draft No. 3 [2 pp., fols. 562 r. & v.]

S^r^

You know that the Commercium Epistolicum conteins the ancient Letters & Papers preserved in the Archives & Letter Books of the Royal Society & Library of M^r^ Collins relating to the dispute between Mr. Leibnitz & D^r^ Keill...

As to Philosophy, he colludes in the signifiations [sic] of words, preferrs Hypotheses to arguments of Induction from experiments, accuses me of opinions w^ch^ are not mine, & instead of proposing Questions to be examined by experiments before they are admitted into Philosophy he proposes Hypotheses to be admitted & believed before they are examined. But all this is nothing to the Commercium Epistolicum.

He complains of the Committee of the Royall Society as if they had acted partially in omitting what made against me...

Draft No. 4 [3 pp., fols. 564 r. & v., 565 r.]

S^r Leicester ffields. London. 26 Feb. 171 $\frac{5}{6}$

You know that the Commercium Epistolicum conteins the ancient Letters & Papers preserved in the Archives [— *i*] & Letter Books [+ *i*] of the Royal Society & Library of M^r Collins relating to the dispute between M^r Leibniz & D^r Keill...

Hitherto [*a*] [— *i*] M^r Leibnitz [+ *i*] avoided returning an Answer to the Commercium Epistolicum... And now he avoids it... by endeavouring to engage me in disputes about Philosophy & about solving of Problems, both which are nothing to the Question.

[*b*] As to Philosophy [*c*] He colludes in the significations of words, [*d*] calling those things miracles w^{ch} create no wonder & those things occult qualities whos causes are occult tho the qualities themselves be manifest, & those things the souls of men w^{ch} do not animate their bodies. His Harmonia præstabilita is miraculous & contradicts the daily experience of all mankind, everyman finding in himself a power of seeing with his eyes & moving his body by his will. He preferrs Hypotheses [*e*] to Arguments of Induction [— *i*] drawn [+ *i*] from experiments, accuses me of opinions w^{ch} are not mine, & instead of proposing Questions to be examined by Experiments before they are admitted into Philosophy he proposes Hypotheses to be [— *i*] admitted & [+ *i*] believed before they are examined. But all this is nothing to the Commercium Epistolicum.

He complains...

I forbear to descend further into particulars. You have them in the Commercium Epistolicum & the Abstract thereof, to both which I refer you. I am

S^r

Yo^r most humble and most obedient Servant

Is. NEWTON.

[*a*] : he *crossed out.* [*b*] : *The following has been crossed out:* I have left off Mathematicks 20 years ago & look upon solving of Problemes as a very unfit argument to decide who was the best Mathematician or invented any thing above 50 years ago. And [*c*] : it is as little to the purpose *crossed out.* [*d*] — [*e*] : *This material appears in a supplementary note at the end of the letter.*

Draft No. 5 [4 pp., fols. 566 r. & v., 567 r. & v.]

S^r

I thank you for shewing me [— *i*] the Postscript to [+ *i*] the Letter of M^r Leibnitz. And for setting those matters in a true light,

[*a*] I [*b*] [— *i*] will [+ *i*] lay them before you [— *i*] in an historical manner [+ *i*] in as few words as I can. [*c*]

[*d*] [— *i*] I [+ *i*] gave an Example of the method of fluxions in [*e*] [— *i*] my [+ *i*] Analysis communicated by D^r Barrow to M^r Collins in the year 1669, & described the universality of it in [*f*] [— *i*] my [+ *i*] Letter to M^r Collins dated 10 Decem. 1672...

M^r Newton neare the end of his said Letter...

... And thus much in answer to the first part of his Postscript. [*g*]

[*a*] : I beg the favour that *crossed out.* [*b*] : may *crossed out.* [*c*] : in an historical manner *crossed out.* [*d*] : M^r Newton *crossed out.* [*e*] : his *crossed out.* [*f*] : his *crossed out.* [*g*] : *This draft ends at this point.*

Draft No. 6 [4 pp., fols. 568 r. & v., 569 r. & v.]

S^r

I thank you for shewing me the Postscript to the Letter of M^r Leibnitz. ffor setting those matters in a true light, I will [*a*] describe them to you in an historicall manner in as few words as I can...

[*a*] : beg[*in*] *crossed out.*

Draft No. 7 [4 pp., fols. 571 r. & v., 572 r. & v.]

S^r

The more I consider the Postscript of M^r Leibnitz the less I think it deserves an answer. ffor it is nothing but a piece of railery from the beginning to the end... On the other [— *i*] hand he himself [+ *i*] [*a*] is guilty of what he complains of in others. ffor he goes from the fact [— *i*] both [+ *i*] when he falls foul upon my Philosophy, & when he sends Mathematical Problems to try who was the best Mathematician [— *i*] 45 or [+ *i*] 50 years ago... After this he falls foul upon my Philosophy, [*b*] that is upon the Philosophy of the ancient [*c*] Phenicians & Greeks as if they had introduced miracles & occult qualities. [*d*] [— *i*] & tells you that he has proved to Mr. Bayle [+ *i*] that the word Miracles signifies [— *i*] not [*e*] only wonders but also [+ *i*] constant events, [— *i*] such as [+ *i*] [*f*] by reason of their constancy create no wonder. [*g*] [— *i*] He tells you also [+ *i*] that God cannot be in the world without animating the world tho a mans soul [— *i*] according to his Philosophy [+ *i*] doth not animate his body. He accuses me as if I said that [*h*] God had a sensorium in a literal sense. He pretends that all places not filled with tangible bodies may be filled with an intangible corporeal fluid, that its the fault of y^e workman & not of the Watch that it will at length cease, & that it would be [*j*] Gods fault if the world should ever want an amendment. [*k*] He commends Exp[erim]entall Philo[so]phy & yet adheres to such Hypotheses as can never be proved by experiments [*l*] & brings [*m*] [— *i*] his hypotheses [+ *i*] as arguments against things proved [*n*] [— *i*]

from [+ *i*] experiments by [*o*] the argum[t] of Induction & thereby endeavours to overthrow that Philosophy, & [*p*] to set up in its room a heap of [— *i*] precarious [+ *i*] Hypotheses w[ch] are nothing better than a Romance.

But I beg leave to acquaint you that its almost 40 years since I left of writing Letters about Mathematicks & Philosophy & twenty years since I left of those studies. And therefore I cannot now suffer myself to be engaged in disputes of this kind; especially since they are nothing to the Question in hand [— *i*] about the infinitesimal method [+ *i*]...

[*q*] He accuses me & by consequence the ancient Phenicians & Greeks [*r*] as if they had introduced miracles & [— *i*] the [+ *i*] occult qualities [*s*] of the Schoolmen into Philosophy. And to make this appear he tells us that he has proved to M[r] Bayle that the word *Miracles,* that is *wonders,* includes the laws [*t*] imprest [— *i*] by God [+ *i*] upon nature tho by their constant acting they create *no wonder,* & that the words *occult qualities* [*u*] signify qualities w[ch] are [*v*] [— *i*] not occult but whose [+ *i*] causes be occult [— *i*] tho qualities be [*w*] very manifest. [+ *i*] He saith that God must be Intelligentiá supramundana because if he were in the world he would [— *i*] be the soul of the world that is he would [+ *i*] animate the world, & yet according to his Philosophy [— *i*] of an Harmonia præstabilita [+ *i*] the soul off a man doth not animate his body. He accuses me [*x*] as if I affirmed that God hath a Sensorium in a litteral sense. He saith that I have not demonstrated [*y*] a vacuum nor universal gravity nor Atomes. But [*z*] he denyes Conclusions without shewing the fault of the Premisses, & [— *i*] means that the Argument of Induction from Experiments upon w[ch] Experimental Philosophy is grounted is not a good one. For [+ *i*] [*aa*] I never attempted to demonstrate any thing [— *i*] universally [+ *i*] in natural Philosophy by any stronger argument then that of Induction from Experiments, [*bb*] [— *i*] And as for Atomes I never attempted to [+ *i*] demonstrate [*cc*] [— *i*] them [+ *i*] by this Argument, but put them amongst a set of Quæres. He saith that Space is the order of coexistences & time the order of successive existences : I suppose he meanes that space is the order of coexistences in space & time the order of successive existences in time, or that space is space in space & time is time in time. He [*dd*] [— *i*] insinuates [+ *i*] that it [*ee*] [— *i*] is [+ *i*] the fault of the workman & not of the materials that a Watch will at length cease to go & in like manner that it would be Gods fault if the world should ever [— *i*] decay & [+ *i*] want an amendment. And by the same way of arguing a man may say that it would be Gods fault if matter do not think [*ff*]. He applauds Experimental Philosophy but recommends Hypotheses to be admitted into Philosophy in order to be examined by experiments : whereas he should propose [— *i*] not Hypotheses [*gg*] to be admitted but [+ *i*] Questions to be examined [— *i*] [*hh*] & decided [+ *i*] by experiments before they are admitted into Philosophy. [*jj*] And whilst he [*kk*] applauds experimental Philosophy & cries out against miracles,

he introduces an Hypothesis of an Harmonia præstabilita w[ch] <is contrary to the daily experience of all Mankind &> [*ll*] cannot be true without a miracle [*mm*], & [— *i*] which [+ *i*] [*nn*] is contrary to the daily experience of all Mankind [*oo*] [— *i*] For all men find by experience that they can move their bodies by their will, & that they [*pp*] see & hear & feel by means of their bodies [*qq*]. <He is of opinion that space void of [— *i*] all [+ *i*] tangible body may be full of a corporeal intangible fluid whereas [*rr*] the Ancients believed that all things intangible were incorporeal. [*ss*] I understand tangibility not in a mathematical but in a physical sense, such a tangibility as by some resistance [— *i*] can [+ *i*] affects the sense of touching.> He glories in the number of disciples, but [*tt*] [— *i*] you know [+ *i*] that he has spent his life in making them by general correspondence whilst I leave truth to shift for it self, ffor its almost 40 years since I left of [*uu*] all correspondence about Math & Philos. & about 20 since I left of these studies. And for that reason I hope you will pardon me if I am averse from being engaged in disputes of this kind.

...

In the Latter part of his Postscript he falls foul upon my Philosophy as if I [— *i*] (& by consequence the ancient Phenicians & Greeks) [+ *i*] introduced Miracles [*vv*] & occult qualities. And to make this appear he gives the name of *miracles* or *wonders* to the laws imprest by God upon nature tho [*ww*] by their constant working they create *no wonder,* & that of *occult qualities* [— *i*] to qualities [+ *i*] w[ch] are *not occult* but whose causes are occult tho the qualities themselves be very manifest.

[*a*] : he ⌊?] *crossed out.* [*b*] : *something illegible crossed out.* [*c*] : Greeks & *crossed out.* [*d*] : *A long passage has been crossed out at this point :* tells you that [*] he has proved to M[r] Bayle that <all the actions of God are miracles [— *i*] or wonders [+ *i*] even tho they happen constantly & by reason of their happening constantly create no wonder, that is, [— *i*] he has proved [+ *i*] that the word miracles signifies [— *i*] constant [+ *i*] events w[ch] create no wonder.>

[*] *This portion has been changed a number of times, so that the exact succession is difficult to determine unambiguously; but apparently at first this portion read :* tells you that they introduced
then it was altered to read : tells you that all the actions of God are miracles
and then it was altered once more to read : tells you that they introduced miracles & occult qualities & that all the actions of God are miracles

[*e*] : only *has been inserted in the insert.* [*f*] : w *crossed out.* [*g*] : And *crossed out.* [*h*] : the world was *crossed out.* [*j*] : the fault of *crossed out.* [*k*] : The [?] *crossed out.* [*l*] : nor have any place in *crossed out.* [*m*] : them *crossed out.* [*n*] : by *intended* [?] *to be crossed out.* [*o*] : means of *crossed out.* [*p*] : *Something crossed out.* [*q*] : After th *crossed out; then* He falls foul upon *crossed out.* [*r*] : for intr [?] *crossed out.* [*s*] : into Ph[*ilosophy*] *crossed out.* [*t*] : of God *crossed out.* [*u*] : do n *crossed out.* [*v*] : manifest to us if their *crossed out*

[manifest *underlined*]. [w] : never *crossed out.* [*x*] : of *crossed out.* [*y*] : uni[*versal*] *crossed out.* [*z*] : he never demonstrated any thing in Philosophy himself, & *inserted and then crossed out.* [*aa*] : [— *i*] He [+ *i*] never demonstrated any thing in Philosophy himself & *crossed out and then reinserted.* [*jj*] : — [*qq*] : *This is an insert, called* saith *crossed out.* [*ee*] : it *altered from* its. [*ff*] : or if humane bodies want a soul *crossed out.* [*gg*] : *Something crossed out.* [*hh*] : decided *crossed out and thenreinserted.* [*jj*] : — [*qq*] : *This is an insert, called for in a footnote.* [*kk*] : comm[*ends*] *crossed out.* [*ll*] : would *crossed out.* [*mm*] : *Newton has inserted the word* incredible, *very likely intending that this portion of the sentence should read* without an incredible miracle. [*nn*] : *The word* which *has been inserted, evidently to make this portion of the sentence read* & which is contrary. [*oo*] : who find *crossed out.* [*pp*] : hear & [*?*] *crossed out.* [*qq*] : *At this point the insert ends.* [*rr*] : *Something crossed out.* [*ss*] : By tangibility *crossed out.* [*tt*] : should consider *crossed out.* [*uu*] : wr[*itings*] *crossed out.* [*vv*] : or wonders into Philos[*ophy*] *crossed out.* [*ww*] : they *crossed out.*

Draft No. 8 [2 pp., fols. 573 r. & v.]

S^r^

The more I consider the Postscript of M^r^ Leibnitz the less I think it deserves an answer. ffor it is nothing but a piece of railery from the beginning to the end... And he might at the same time see my Analysis w^ch^ D^r^ Barrow in the year 1669 communicated to M^r^ Collins, & in w^ch^ my method of moments & fluxions was described before M^r^ Leibnitz knew any thing of Geometry.

Draft No. 9 [incomplete, 2 pp., fols. 589 r., 591 r.]

Of this draft we have been able to find neither beginning nor end. The two leaves are not with the other eight drafts (Part 83, Add. 3968), but are placed in Part 39, among papers giving drafts of part of the Recensio *of the* Commercium Epistolicum *written by Newton for the* Philosophical Transactions. *Fol. 591 r. begins as follows :*

of Geometry, which is the glory of this science, admitted no Propositions into it till they were demonstrated by composition : so I first invented the Propositions in the Book of Principles by Analysis & then demonstrated them by composition that they might be admitted into Geometry. And tho this Book was written by Composition (as all things in Geometry ought to be) yet the Analysis of moments shines through the composition so clearly that the Marquis de L'Hospital wrote that this Book was *presque tout de ce calculs,* & M^r^ Leibnitz himself that it was a proof that I had this Analysis, & the first [— *i*] public [+ *i*] proof which any man gave that he had it.

D^r^ Wallis died in October 1703, the last of the old men who knew what had passed between M^r^ Leibnitz & me by means of M^r^ Oldenburg. And afterwards I was accused in the Acta Eruditorum & before the Royal Society as a Plagiary who had substituted [*a*] Fluxions for Differences & thereby taken the Method from M^r^ Leibnitz. And when the Royal Society caused the ancient Letters & Papers [*b*] remaining in their Archives & Letter Books & in the Library of M^r^ Collins to be published all w^ch^ are unanswerable matter of fact : instead of answering the same in a fair manner, & proving his accusation of plagiary against me, a defamatory Libel was published against me in Germany without the name of the Author or Publisher or City where it was published, & dispersed over Germany France & Italy, & the Libel it self represents that M^r^ Leibnitz set it on foot.

In the latter part of his Postscript he [— *i*] departs from the Question & [+ *i*] falls foul upon my Philosophy... [*c*].

[*a*] : Diff[*erences*] *crossed out.* [*b*] : to be *crossed out.* [*c*] : *We have not printed the bulk of the remaining paragraph at this point, since it has been printed earlier in the article; see pages* 000 *above.*

Draft No. 10 [4 pp., fols. 436 r. & v., 437 r.]

In the second part of his Postscript he tells you that if all bodies be heavy gravity must be a scholastick occult quality & a miracle notwithstanding that it may be supposed to act constantly by a certain law imprest by God upon the nature of things; that is to say it must [be] a miracle tho it be no [*a*] miracle [*b*]. For Miracles are so called because they happen seldome & [*c*] [— *i*] for that reason [+ *i*] create wonder. All qualities are occult whose causes are not known, & M^r^ Leibnitz has not yet told us the cause of Gravity. But a Scholastick occult quality is that whose cause in our opinion cannot be found out because it was unknown to Aristotle, & no body can go beyond him. M^r^ Newton holds no such opinion, but leaves it to [*d*] [— *i*] every man [+ *i*] to find out the cause of gravity if he can.

But M^r^ Leibnitz [*e*] insinuates that gravity must be caused by the action or impulse of [*f*] some bodies or subtile matter & the matter w^ch^ causes gravity cannot gravitate it self. He goes upon the Hypothesis of the materialists viz that all the phænomena in nature are caused by mere matter [— *i*] & motion [+ *i*] & man himself is a mere machine [*g*]. His body is not actuated by [*h*] any mind that moves by mere mechanism. [*j*] And his zeale for this precarious hypothesis makes him rail at M^r^ Newton's universal gravity. He denys none of M^r^ Newtons experiments. He denys not the third Rule of Philosophy. And yet from [*k*] the Experim^ts^ & that Rule [*l*] universal gravity necessarily follows. But he [*m*] denys the conclusion. And indeed he has a very [— *i*] good [+ *i*] faculty at denying conclusions. That third Rule is the Rule of Induction. And without it no Proposition can become general in Naturall Philosophy. Without it we cannot affirm that all bodies are impenetrable. And the argument [— *i*] by Induction [+ *i*] for universal gravity is as strong as the argument for universal impenetrability. Yet Arguments from Induction are not Demonstrations. They are only to take place till some [— *i*] experimental [+ *i*] exception can be found. And if M^r^ Leibnitz out of [*n*]

zeale for the Hypothesis of the Materialists will except his subtile matter, [*o*] the exception will do Mr Newton's Philosophy no harm. [*p*] [— *i*] And by the same liberty any body also may eccept the Impenetrability of the particles of his subtile matter. [+ *i*]

He saith that God is Intelligentia supramunda [!] because he is not the soul of the world [— *i*] & has no need of a sensorium [+ *i*] : as if the [*q*] soul of a man would be the soul of the pictures of visible objects made in the sensoriû if it were in the [*r*] [— *i*] place where they are made, [+ *i*] or as if any man except the Anthropomorphites [s] ever feigned that God had a Sensorium in a litteral sence. But what he means by banishing God out of the [*t*] world wants an explication. Doth he mean that God is beyond [*u*] all space : a being that's nusquâ. And is he angry at Mr Newton for saying that God is every where & that he is not [— *i*] far [+ *i*] from [*v*] every one of us; for in him we live and move & have our being.

He saith that he is astonished that Mr Newton should [— *i*] believe that God [+ *i*] hath made the world so ill that [w] that like a watch it would at length cease to go without the extraordinary hand of God; [*x*] & that this is to have very narrô Ideas of Gods [— *i*] wisdom & power [+ *i*]. And by the same Argument any man may [*y*] affirm that [— *i*] God [+ *i*] was able to endow matter wth an [*z*] [— *i*] active & [+ *i*] self moving principle, & enable it to think, & therefore has done it because he is wise & good, & that God created the world from all Eternity & made it a being absolutely perfect because he was able to do so, [*aa*] [— *i*] that [+ *i*] to deny all this is to have narrow ideas of Gods power & wisdome & goodness.

He commends experimental Philosophy, but adds that when experiments are wanting, it is allowed to imagin Hypotheses [— *i*] & [+ *i*] expect till new experiments shall determin which of them are true [*bb*] & upon this account he thinks his philosophy may be justified. But he should consider that Hypotheses are nothing more then imaginations, conjectures, & suspicions & ougt not to be propounded as Truths or Opinions nor admitted into Philosophy as such until they are verified & established by experiments. And if you consider his [*cc*] Philosophy you will find that it consists [*dd*] [— *i*] generally in such Hypotheses [+ *i*] as [*ee*] can never be established by experiments : Such as are That God is intelligentia supramundana, that [*ff*] [— *i*] the bodies of animals are moved not by the mind or will of the animal but mechanically by [+ *i*] an Harmonia præstabilita that all the Phænomena in Nature are purely mechanical. That the world [*gg*] is so perfect that [— *i*] it [+ *i*] can last for ever without running into disorder, that the Planets revolve in Vortices, That God has never intermedled with the frame of things since the first creation. [*hh*]

It's not impossible but that [— *i*] an [+ *i*] exception may be found in time. But [*jj*] a mere hypothesis or supposition of an exception is no exception. The exception ought to be [*kk*] experimental. The meaning of [*ll*] Conclusions [*mm*] made by Induction is that they are to be looked upon as general till some [— *i*] reale [+ *i*] exception

appeare. [*nn*] And in this sense gravity is to be looked upon as universal [*oo*]. To make an exception upon a mere hypothesis is to feign an exception. It is to reject the argument from induction, [*pp*] & turn Philosophy [*qq*] into a heap of Hypotheses, [*rr*] [— *i*] which are no better then [+ *i*] a chimerical Romance.

[*a*] : *Something illegible crossed out.* [*b*] : miracle *was at first* miracles. [*c*] : the very *crossed out.* [*d*] : Mr Leibnitz *crossed out.* [*e*] : tells us *crossed out.* [*f*] : some other bo *crossed out.* [*g*] : *something illegible crossed out.* [*h*] : his will [?] *crossed out.* [*j*] : And *crossed out.* [*k*] : *something illegible crossed out.* [*l*] : *something illegible crossed out.* [*m*] : has an extraordinary *crossed out.* [*n*] : fondn *crossed out.* [*o*] : *something illegible crossed out.* [*p*] : Tho it be an irregular *crossed out.* [*q*] : *something illegible crossed out.* [*r*] : sensorium *crossed out.* [*s*] : He saith that God hath no need of a Sensorium *crossed out.* [*t*] : Universe *crossed out.* [*u*] : the *crossed out.* [*v*] : any of *crossed out.* [*w*] : it should have made the world so ill *crossed out.* [*x*] : And *crossed out.* [*y*] : thin [?] *crossed out.* [*z*] : *something illegible crossed out.* [*aa*] : *something illegible crossed out.* [*bb*] : *something illegible crossed out.* [*cc*] : Philo [?] *crossed out.* [*dd*] : in such opinions *crossed out.* [*ee*] : cannot *crossed out.* [*ff*] : there is *crossed out.* [*gg*] : *originally* wold. [*hh*] : *The preceding paragraph is a fragment occupying only one-third of a page. Nothing else appears on this page.* [*jj*] : the exception *crossed out.* [*kk*] : grounded upon some phae *crossed out.* [*ll*] : *Something illegible crossed out.* [*mm*] : drawn from In *crossed out.* [*nn*] : Mr New *crossed out.* [*oo*] : till some [— *i*] real [+ *i*] exception appeare *crossed out.* [*pp*] : *something illegible crossed out.* [*qq*] : without [?] *crossed out.* [*rr*] : that is, into *crossed out.*

Draft No. 11 [incomplete, 1 p., fol. 587 v.]

This paragraph has been printed in full above, see pp. 74-75.

Draft, No.12 [incomplete]

This paragraph has been printed by A. R. Hall and M. B. Hall; see above, page 78.

NOTE ON THE DATE OF NEWTON'S LETTER TO CONTI : From the 12 drafts of this letter, it is clear that Newton took some time in composing it. The final version bore the date 26 February 1715/16 (Julian; Old Style), the same date as Draft. No. 4. Leibniz (see note 33 *supra*) wrote his letter to the Abbé Conti on 6 Dec. 1715 (Gregorian; New Style), which must have reached Newton in the first days of December (O. S.). Clarke's Second Reply to Leibniz was transmitted with a letter from the Princess of Whales dated 20/30 December 1715. Since there is no reason to suppose that Newton had not begun to draft his reply to Leibniz's letter to Conti as soon as he saw it, Newton could perfectly well have been writing this reply while Clarke was writing his Second Reply to Leibniz. It was in this letter of transmittal that the Princess wrote : « Vous ne vous étiez point trompé à l'odeur des réponses; elles ne sont pas écrites sans l'avis du chevalier Newton ». (See Robinet, *op. cit.*, pp. 45-46.)

APPENDIX TWO

The Measurement of Force (1) : *Newton's Draft of Clarke's Critique of Leibniz's Principles of Motion*

In Clarke's « Fifth Reply », i. e., his reply to Leibniz's « Fifth Paper », the question arises of the measurement of the « quantity of impulsive force » in a moving body. At issue were the concepts of momentum (Newton's « quantity of motion » or mv) and *vis viva* (mv^2) or kinetic energy, properly $\frac{1}{2}\ mv^2$. In considering problems of the collision of bodies, the Newtonians quite properly measured the force of each moving body by its momentum, since in collisions it is momentum that is conserved. But the Leibnizians concentrated on problems such as the raising and dropping of bodies, in which energy is conserved. Only when the clear distinction had finally been made by D'Alembert in the second edition of his *Traité de Dynamique* (1758), some decades after Newton and Leibniz were both dead, was it seen that both schools had some of the right on their side.

Clarke (2) discusses Leibniz's supposed error in a lengthy footnote to his « Fifth Reply » (accompanying §§ 93-95). Leibniz, he says, considered the quantity of matter in a body and the space through which it moves, but failed to take the time into account. Leibniz's argument may be summarized thus : If force F will raise body A of mass m to a height h, and body B has a mass nm, then that same force F will raise body B to a height h/n. Clarke declares that Leibniz had confused « cases where the times are equal with the cases where the times are unequal ». Thus the case « of bodies rising and falling at the ends of the unequal arms of a balance » is « confounded » by Leibniz « with that of bodies falling downwards and thrown upwards, without allowing for the inequality of time ». Let a body be thrown upward with velocity v, so as to rise a height h in time t. If the initial velocity were $2v$, then in time $2t$ it would rise not $2h$ but $4h$. Its « impulsive force » would not, however, be increased « in proportion of the space described by its ascent,

(1) See page 80, above.

(2) This question is discussed by Alexander in his edition of *The Leibniz-Clarke correspondence*, pp. xxix sq. See also René Dugas : *Mechanics in the seventeenth century* (Neuchâtel : Editions du Griffon, 1958), ch. XIV, §§ 4-7, 10. Clarke published an article on « the proportion of velocity and force in bodies in motion, » *Phil. Trans.*, 1728, No. 401, *35* : 381-388.

but in the proportion of that space applied to the time; that is, in the proportion of $\frac{4}{2}$ to $\frac{1}{1}$ or 2 to 1 ».

Next, says Clarke, consider a falling body in a medium « void of resistance », following Galileo's demonstration « on the supposition of gravity being uniform ». Divide the time into equal parts. Since gravity is uniform, in each « equal part of time » it must act « equally », and « by its action impress and communicate to the falling body, equal impulsive forces, velocities, and motions, in equal times ». Hence « the impulsive force, the velocity, and the motion » will increase uniformly with the time of falling. But the distance fallen s, is not proportional to the time t. Rather (3),

$$s \propto t^2 \qquad \text{and} \qquad {}_s\alpha^{\delta v^2}.$$

If, in fact, the body falls from rest, and the acceleration is g, then these two relations are

$$s = \tfrac{1}{2}\ g\ t^2 \qquad\qquad s = v^2/2g.$$

Let f be the Newtonian force, in the sense of measuring the rate of change of quantity of motion ($\Delta mv/\Delta t$), and let the acceleration g be constant, so that the force of gravity f is also constant, where

$$f = mg.$$

The change in momentum when the body falls freely during a time-interval Δt is

$$\Delta mv = mv_2 - mv_1 = m\ (v_2 - v_1) = m\ .\ \Delta v$$

where v_1 is the initial speed and v_2 the terminal speed. Since

$$f = \Delta mv/\Delta t = mg$$

it follows that

$$f\ .\ \Delta t = m\ (v_2 - v_1).$$

The quantity $f\ .\ \Delta t$ is known as the « impulse » and, since f is constant, it follows (as Clarke writes) that the « impulse » or « impulsive force » is proportional to the time Δt. Furthermore, the increase in velocity Δv is

$$\Delta v = v_2 - v_1 = g\ .\ \Delta t.$$

Thus since g is a constant, Δv is proportional to Δt. It follows that if Δv is proportional to Δt, the « motion » (i. e., quantity of motion) *must also change proportionally to* Δt.

What is of concern to us here, however, is not so much the substance of Clarke's Newtonian criticism of Leibniz in this note as the origin of it. Among the Newton MSS there are two fragments

(3) In the remainder of this paragraph we have presented Clarke's argument in modern notation.

relating to this subject. Both are to be found in a mass of assorted documents in the Portsmouth Collection, Cambridge University Library, Add. 3968/41, with separate numbering, contained in the empty vellum cover of a book. The first of these is a small scrap of paper, written on both sides, fol. 10 r. & v. As before, all inserted matter is distinguished by a pair of inclusive symbols :

$$[-i] \ldots [+i].$$

[*a*] And if a body ascend, [*b*] the gravity of the body by acting [— *i*] upon it [+ *i*] equally in equal times will take of equal velocities of ascent in those equal times, or that [*c*] the whole force imprest, [*d*] the wole time of ascent to any height [*e*] & the whole velocity taken of in that [*f*] time are proportional to one another [— *i*] but not to the space of ascent. [+ *i*] [*g*] The whole space of ascent will [*h*] [— *i*] arise from the time & velocity together & be in compound ratio of them both, that is, as the square of either of them. And upon these rules of [*j*] ascending & descending, Galileo demonstrated that projectiles would, in spaces void of resistance, describe Parabolas. And all Mathematicians [*k*] (not excepting Mr Leibnitz himself) unanimously agree that he was in the right. And yet Mr Leibnitz would have us measure the force imprest, not by the velocity generated to wch it is proportional but by the space of ascent to which it is not proportionall.

Galileo argued that uniform gravity by acting equally in equal times upon a falling body would produce equal velocities [— *i*] of descent [+ *i*] in those times, or that the whole force imprest, the whole time of descent & the whole velocity acquired [— *i*] in falling [+ *i*] would be proportional to one another, but the whole descent or space described would [*l*] [— *i*] arise from the time & velocity together & there be in a compound ratio of them both, or as the [+ *i*] square [*m*] of [*n*] [— *i*] either of them [+ *i*]. [*o*]

[*a*] : nal [?] *crossed out.* [*b*] : grav *crossed out.* [*c*] : *a* 2 *within a circle inserted,* [*d*] : *a* 1 *within a circle inserted. Hence the order of these phrases was to be :* or that the whole time of ascent to any height, the whole force imprest, & the whole velocity... [*f*] : *an illegible word crossed out.* [*g*] : But [?] *crossed out.* [*h*] : be as the velocity & time together *crossed out.* [*j*] : desce *crossed out.* [*k*] : acquiesce *crossed out.* [*l*] : be as the time of descent & the velocity of descending together, that is as the *crossed out.* [*m*] square *was originally* squares. [*n*] : the times of descent *crossed out.* [*o*] : *The following three sentences were crossed out :* And hereby he demonstrated that a Projectile in a space void of resistance describes a Parabola. And mathematicians unanimously agree that he was in the right, Mr Leibnitz himself being one of them. And yet he measures the force imprest, not by the velocity acquired to wch it is proportional, but by the space of descent to wch it is not proportional.

The second fragment is considerably longer and occupies folio 44 r. & v. In transcribing this document we have used angle-brackets

<...> where Newton used square brackets to avoid confusion with the modern use of square brackets for editorial insertions.

The reason of his inconsistency in this matter was his computing by a wonderful unphilosophical errour, the quantity of impulsive force [*a*] acquired by a falling body from the quantity of its matter & [— *i*] of [+ *i*] the space described by it in falling; recconing the force acquired to be in a compound ratio of the matter & [— *i*] the [+ *i*] space [*b*] [— *i*] together [+ *i*]. Now [— *i*] matter is as the weight thereof & [+ *i*] the space described is as the square of the time of [— *i*] its [+ *i*] falling, & therefore according to Mr Leibnitz the force acquired in falling is [*c*] in a compound ratio of the [*d*] weight of the falling body & the square of the time of its falling. And by consequence, where the weight remains the same, the force acquired in falling will be as the square of the time. So that if the time [— *i*] of falling [+ *i*] be divided into equal parts, & in the first part of ye time one degree of impulsive force be acquired, in the two first parts of time four degrees of force will be acquired, in the three first parts of time nine degrees of force will be acquired, [*e*] in the four first parts of time sixteen degrees of force will be acquired, & so on. [*f*] And therefore if in the first part of the time one degree of [*g*] impulsive force be acquired in the second part of the time three degrees of force [*h*] will be acquired, in the third part of the time five degrees of force will be acquired in the fourth part of time seven degrees of force will be acquired, & so on. And [*j*] [— *i*] so [+ *i*] the [— *i*] Weight or [+ *i*] gravity of the body which [*k*] by its action impresses these impulsive forces upon the body, acts with three times more force in the second part [*l*] of [— *i*] the [+ *i*] time then in the first & with five times more force in the third part of the time then in the first & with seven times more force in the fourth part of the time then in the first, & so on. Which is as much as to say that the [*m*] falling body grows heavier & heavier as it falls, & becomes three times heavier in the [— *i*] midle [*l*] of the [+ *i*] second part of the time then in the [— *i*] middle of the [+ *i*] first & five times heavier in the [— *i*] middle of the [+ *i*] third part of the time then in the [*n*] middle of the first, & so on. Or that the weight of the body is proportional to the time of its falling. And by consequence that in the beginning of the first part of the time the body [*o*] hath [*p*] no weight at all. Which is contrary to the Hypothesis of uniform gravity & to experience it self.

The Theory of Projectiles invented by Galilæo is founded upon the Hypothesis of uniform gravity, & it generally approved by Mathematicians. Now uniform gravity is that which acts with an uniform force & in equal times [*q*][— *i*] by acting with [*r*] equal force upon the body [+ *i*] communicates equal forces to it. If in the first part of time it communicates one degree of force & gives one degree of velocity [— *i*] to the falling body [+ *i*]; in the second part of time by acting as much as in the first, it will communicate another degree of force & give another degree of velocity to the falling body; & in the third

part of time it will generate a third part of force & a third degree of velocity & so on perpetually : & therefore [*s*] [— *i*] the time of falling [+ *i*] the force imprest, & the velocity of descent will be always proportional to one [*t*] one another. But the space described by the falling body arises partly from the time of descent & partly from the velocity of the falling body & therefore will be in a compound ratio of them both or as the square of either of them, & by consequence as the square of the force.

And so if two equal bodies be thrown directly upwards the one with [*u*] [— *i*] a [+ *i*] velocity [*v*] double to that of y^e^ other, the swifter body will rise four times higher then the other in [*w*] twice the time & in that time the action of gravity upon it [— *i*] for taking away the force by w^ch^ it ascends [+ *i*] will be double to the action of gravity upon the other body, & therefore the force by w^ch^ it ascended & w^ch^ is taken away by that action, is only double to the force by w^ch^ the other body ascended.

A body therefore of one pound weight is not (as M^r^ Leibnitz supposes in the Acta Eruditorum ad Annum 1686 pag. 162) thrown in Vacuo four [*x*] times as high but sixteen times as high by the same quantity of impulsive force wherewith a body of four pound weight is thrown one foot high. The ground of his error is that he confounds <Acta Erudit : ad Ann. 1686 pag. 162; & ad Ann. 1690 pag. 234; & ad Ann. 1691 pag. 439; & ad Ann. 1695 pag. 155> the spaces described [— *i*] in unequal times [+ *i*] by bodies falling downwards or thrown upwards with the spaces described [*y*] by bodies rising & falling in equal times at the ends of the unequal arms of a ballance. Whereas in the first case the spaces [— *i*] described [+ *i*] are as the time & the veocity together, that is, as the square of the velocity : in the second case the times being equal the spaces [— *i*] described [+ *i*] are only as the velocities.

And because tis true that in an horizontal plane, where gravity neither adds to nor takes from the Velocity, a body of four pound weight will [*z*] be carried one foot by the same force [— *i*] imprest at once [+ *i*] whereby a body of one pound weight will [*aa*] [— *i*] in [+ *i*] y^e^ same time be carried on four feet : therefore he supposes <Acta Erudit : ad Ann. 1686 pag. 162>, that in a perpendicular plane wherein [*bb*] Gravity continually augments or diminishes the [*cc*] velocity in proportion to the time of its acting; a body of four pounds weight will be thrown upwards one foot by the same force imprest at once whereby a body [*dd*] [— *i*] of one [+ *i*] pound weight will be [*ee*] [— *i*] carried up [+ *i*] four foot; or that a body of One pound weight [*ff*] in falling four foot, will acquire the same impulsive [*gg*] force as a body of four pounds weight in falling one foot. Then w^ch^ nothing can be more contrary [*hh*] both to reason & experience.

[*a*] : from the quantity of matter *crossed out.* [*b*] : described *crossed out.* [*c*] : as the *crossed out.* [*d*] : matter falling *crossed out, replaced by* in a falling body *which was then crossed out.* [*e*] : & so on perpe [*tually*] *crossed out.* [*f*] : Or if in th *crossed out.* [*g*] : force *crossed out.* [*h*] : , will in the third *crossed out.* [*j*] : if *crossed out.* [*k*] : is supposed to be uniform & by wh *crossed out.* [*l*] : part *was originally* parts. [*m*] : th falling *crossed out.* [*n*] : first *crossed out.* [*o*] : would *crossed out.* [*p*] : hath *was originally* have. [*q*] : *originally* acts equally upon it & by acting with an equal force — *or possibly* acts equally by acting with an equal force — by acting equally. [*r*] : an *crossed out.* [*s*] : the time of falling *crossed out.* [*t*] : one another, to the time of falling & to *crossed out.* [*u*] : double *crossed out.* [*v*] : to *crossed out.* [*w*] : four times *crossed out and replaced by* three *which was then crossed out.* [*x*] : *an illegible word crossed out.* [*y*] : in equal times *crossed out.* [*z*] : at the same *crossed out.* [*aa*] : at *crossed out.* [*bb*] : the force is not imprest at once but *crossed out.* [*cc*] : force impr *crossed out.* [*dd*] : four *crossed out.* [*ee*] : thrown upwards *crossed out.* [*ff*] : will *crossed out.* [*gg*] : velocity *crossed out.* [*hh*] : to experience *crossed out.*

That these documents, or some variants of them, were actually the source of Clarke's note may be seen by quoting a few lines of Clarke's which repeat not only Newton's argument, but even his very words and (in one instance) his spelling :

The Reason of his Inconsistency in this Matter, was his computing, by a wonderfully unphilosophical Error, the Quantity of Impulsive Force *in an* Ascending Body, *from the Quantity of its* Matter *and of the* Space *described by it in Ascending..*

Upon the Supposition of Gravity being Uniform, Galilæo *demonstrated the Motion* of Projectiles *in Mediums void of Resistance; and his Propositions are allowed by all Mathematicians, not excepting Mr.* Leibnitz *himself.*

... the Force requisite *to make the Body* B, *of* four Pounds Weight, *rise up* one Yard, *will make the Body* A, *of* One Pound Weight, *rise up,* (*not* four Yards, as *Mr.* Leibnitz *represents, but*) sixteen Yards, *in* quadruple *the Time...*

If the Force *acquired by a Body in falling, be as the* Space described; *let the* Time *be divided into* equal *parts; and if in the* first *part of* Time *it gain* One *part of* Force, *in the* two first *parts of* Time it *will gain* four *parts of* Force, *in the* three first *parts of* Time *it will gain* nine *parts of* Force, *and so on. And by consequence, in the* second *part of* Time *it will gain* three *parts of* Force, *in the* third *part of* Time *it will gain* five *parts of Force, in the* fourth *part of* Time *it will gain* seven *parts of* Force, *and so on. And therefore if the* Action of Gravity *for* generating *these* Forces, *be supposed, in the middle of the* first *part of* Time, *to be of* One *degree; it will, in the middle of the* second, third, *and* fourth *parts of* Time, *be of* three, five, *and* seven *degrees, and so on; that* is, *it will be proportional to the* Time *and to the* Velocity acquired...

[1717 ed., pp. 329-339].

Unfortunately, we cannot tell exactly when Newton wrote out the above fragments, although the date must of course be prior to

1717, when Clarke published his long note based on them. But these fragments do provide further evidence of Newton's participation in the « Leibniz-Clarke Correspondence ».

APPENDIX THREE

Newton and Des Maizeaux's « Recueil »

In the Portsmouth Collection of Newton papers, one section (Add. 3968) consists of materials relating to the Newton-Leibniz controversy. Section 27 bears the heading : « Several drafts of Letters of Newton to Des Maizeaux after the death of Leibnitz. » Here one will find a large number of drafts in English (fols. 385 sq.) of a letter from Newton to Des Maizeaux telling him of an error in the order of letters in « the printed sheets w^{ch} you left in my hands ». This error was corrected by Des Maizeaux in the second edition. Newton told Des Maizeaux that « None of the Letters being written to me, I did not think it my self concerned to answer any of them till M^{r} l'Abbé Conti sollicited me to answer the Postscript of his first Letter » so « that my Answer as well as that Postscript might be shewed to the King ». The contents of this letter, describing the controversy, are also to be found in MS in Newton's hand in English in the form of a foreword (« To the Reader ») evidently intended for Des Maizeaux. In some of the drafts of the letter, Newton also corrected some misprints in the texts printed by Des Maizeaux. A little later in this section of MSS (fol. 404) Newton gives a slightly different version of the above story; he says here that the Abbé Conti first « shewed to the King » the Leibniz letter and postscript and that then « I was pressed to write an answer » which might « be also shewed to the King ». A copy of a letter or statement in French relates the background of the *Recueil* and certain aspects of Newton's quarrel with Leibniz.

Section 28 is headed : « Remarks on Leibnitz's 1st Letter to the abbé Conti. » It begins with a series of Newton's comments (by page and line) on Leibnitz's « apostille ». In one of these (fol. 415), Newton writes :

> ... Galileo began to consider the effect of Gravity upon Projectiles. M^{r} Newton in his Principia Philosophiæ improved that consideration into a large science. M^{r} Leibnitz christened the child by [*a*] new name as if it had been his own calling it *Dynamica*. M^{r} Hygens gave the name of vis centrifuga to the force by w^{ch} revolving bodies recede from the

> center of their motion [.] M^{r} Newton [— *i*] in honour of that author [+ *i*] retained the name & called the contrary force vis centripeta...

These comments occupy 14 MS pages in all.

Section 29 is headed « Remarks on Leibnitz's 2d letter to the abbé Conti ». This material is often all but identical with that found in Section 27. Thus there are further drafts of the letter to Des Maizeaux giving a history of the correspondence with Conti. Of these letters and remarks, Newton says, « I caused them to be published as soon as I heard that he [Leibniz] was dead, & you may reprint them w^{t} such other Letters as are fallen into your hands ».

Another section dealing with Des Maizeaux is 36, headed : « Contents of Des Maizeaux's Recueil & Copies of Letters which are published in Des Maizeaux's Recueil. » Here (fols. 507 sq.) there is a letter from Des Maizeaux to Newton (London, June 4, 1720) informing the latter that the « Impression of my collection of Pieces of Mr. Leibniz &c. is at last finish'd » and that he is sending Newton « the Preface enclos'd; which I desire you would take the trouble to read. » It seems likely that the « Avertissement au Lecteur » was written by Newton either on receipt of the text of Des Maizeaux's Preface or on learning of the plans of Des Maizeaux to reprint the « Leibniz - Clarke Correspondence ». Des Maizeaux enclosed a table of contents, which Newton copied out and then rewrote several times in a corrected chronological order (fols. 512 sq.). There are also copies of some letters of Leibniz, chiefly in the hand of a professional amanuensis, but also partly in Newton's hand.

APPENDIX FOUR

« Indiscerpibility » : Newton and Henry More

In footnote 64 above, attention was called to the fact that the two recent editors of the « Leibniz-Clarke Correspondence » silently corrected the term *indiscerpible* which was used by Clarke to make it read *indiscernible*. We have a called this an « over-correction » because it has needlessly altered a most significant word and thereby cancelled a further link between Clarke and Newton, via Henry More.

So far as is known, the adjective *indiscerpible* was used for the first time in English by Henry More in his *The immortality of the soul, so farre forth as it is demonstrable from the knowledge*

of nature and the light of reason (London : William Morden, 1659). In the preface (p. *a*5) More writes :

I have taken the boldness to assert, That Matter consists of parts indiscerpible, understanding by indiscerpible parts, particles that have indeed real extension, but so little, that they cannot have less and be any thing at all, and therefore cannot be actually divided. Which minute extension, if you will, you may call *Essential* (as being such that without that measure of it, the very Being of *Matter* cannot be conserved) as the extension of any Matter compounded of these you may, if you please, term *Integral;* these parts of this compounded Matter being actually and really separable one from another. The Assertion, I confess, cannot but seem paradoxical at first sight, even to the ingenious and judicious. But that there are such *indiscerpible* particles into which *Matter* is divisible, *viz.* such as have *essential* extension, and yet have parts utterly inseparable, I shall plainly and compendiously here demonstrate (besides what I have said in the Treatise it self) by this short Syllogism.

That which is actually divisible so farre as actual division any way can be made, is divisible into parts indiscerpible.

But Matter (I mean that *Integral or compound* Matter) is actually divisible as farre as actual division any way can be made.

It were a folly to goe to prove either my Proposition or Assumption, they being both so clear, that no common notion in *Euclide* is more clear, into which all Mathematical Demonstrations are resolved.

It cannot but be confessed therefore, That Matter consists of *indiscerpible* particles, and that physically and really it is not divisible *in infinitum*, though the parts that constitute an *indiscerpible* particle are real, but divisible onely intellectually; it being of the very essence of whatsoever *is*, to have parts or extension in some measure or other.

NOTE : In the original preface the foregoing extract was printed in italic type with an occasional word in roman; for easier reading we have printed the text in roman and have italicized those occasional words that were in roman type.

According to Murray's *A New English Dictionary on historical principles* (reprinted and later known as *The Oxford English Dictionary*), the terms *indiscerpible, indiscerpibleness, indiscerpibility, indiscerpibly* (and later *indiscerptible...*) are also to be found in writings by Joseph Glanville (1662), Ralph Cudworth (1678), Joseph [?] Kelsey (1703), Henry Wotton (1722) ; curiously enough, this listing omits Samuel Clarke (1713). Clarke, of course, could have found the word in Glanville, Cudworth, or Kelsey, or he might have come upon it by reading More himself. It is also possible, however, that Clarke's reference to *indiscerpibility* derived from Newton.

One of Newton's college notebooks (Cambridge University Library, MS Add. 3996) is marked on the title-page :

Isaac Newton
Trin : Coll Cant
1661

This notebook thus dates from Newton's first year at Trinity College (*aetate* 19) and reveals to us some of the earliest stages of his scientific thought. This book contains notes on many subjects, such as « Aer, Antipathy, Asperity, Attoms, Attraction..., Sound, Sapors, Sympathy, Time, Tractibility, Touch, Vacuum, Vortex, Vndulation, Vision, Vegitables ». Even at this early age he was questioning Descartes' philosophy. Thus p. 11 (folio 93 recto) begins :

Of y^{e} Celoestial [!] matter & orbes.

Whither Cartes his first element can turne about y^{e} vortex & yet drive y^{e} matter of it continually from y^{e} ⊙ to produce light... & whither when y^{e} ⊙ is obscured y^{e} motion of y^{e} first element must cease (& so whither by his hypothesis y^{e} ⊙ can be obscured) & whither upon y^{e} ceasing of y^{e} first elements motion y^{e} Vortex must move slower...

And on p. 12 we find him asking « Whither ⊙ move y^{e} vortex about (as Des-Cartes will) by his beames. pag 54 Princip Philos : partis 3^{ae}. Whither y^{e} vortex can carry a Comet towars y^{e} poles &c. » One of the most interesting parts is the discussion « Of Gravity & Levity » (p. 19, fol. 97r.), where we find : « The matter causing gravity must pass through all y^{e} pores of a body. it must ascend again i for else y^{e} bowells of y^{e} earth must [?] have had large cavitys & inantys to contein it in, 2 or else the matter must swell it... » Elsewhere (f. 121) he describes an instrument to measure the « gravity of a body in divers places as at y^{e} top & bottome of a hill; in different latitudes &c. » He relates that « In y^{e} descention of a body there is to be considered y^{e} force w^{ch} it receives every moment from its gravity... & y^{e} opposition it receives from y^{e} aire (w ^{h} increaseth in proportion to its swiftnesse) » and proposes « an experiment concerning this increase of motion ». He observes that « According to Galilaeus a iron ball... descends an 100 braces fflorentine or cubits (or 49,01 ells, perhaps 66^{yds}) in 5" of an hower. » This datum corresponds to an acceleration of 31.44 ft/sec^{2}.

Newton notes, furthermore, that « The gravity of bodys is as their solidity, because all bodys descend equall spaces in equall

times, consideration being had to the Resistance of y^e aire &c. » Among the experiments he proposes is one on gravity which gives us a full measure of the gulf separating this young Newton from the mature author of the *Principia* :

Try whither y^e weight of a body may be altered by heate or cold, by dilation or condensition, beating, poudering, or transfering to serverall places on seve[r]all heights, or placing [— *i*] a hot or [+ *i*] heavy body over it, [— *i*] or under it, [+ *i*] or by [placing *crossed out*] magnetisme. Whither leade or its dust spread abroade, whither a plate flat ways or edg ways is heaviest. Whither y^e rays of gravity may bee stopped by reflecting or refracting y^m, if so a perpetuall motion may be made one of these two ways.

Among these notes, questions, and proposed experiments, the first topic in the book is the « first matter »; after an introductory section, we find (p. 3, fol. 89r.) :

It remaines therefore y^t y^e first matter must be attoms. And y^t Matter may be so small as to be indiscerpible. The excellent D^r Moore in his booke of y^e soules imortality hath proved — beyond all controversie [;] yet I shall use one argument to shew y^t it cannot be divisible in infinitum & y^t is this : Nothing can be divided into [infinite *crossed out*] [— *i*] more [+ *i*] parts y^n *it* can possibly be constituted of. But matter (i. e. finite) cannot be constituted of infinite parts. The Major is true for looke into how many parts a thing is divided those parts added againe make y^e same whole that they were before, & so if any finite quantity were divided into infinite parts (& certainly it may if it be so far divisible) those infinite parts added would make y^e same finite quantity they were before w^ch is against y^e Minor...

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* We should like to express our gratitude to the National Science Foundation (U. S. A.) for financial support of the research on which this article is based.

Notes et Documents

THE "HISTORY OF RECENT PHYSICS" PROJECT OF THE AMERICAN INSTITUTE OF PHYSICS

L'organisation aux Etats-Unis de recherches coordonnées sur l'histoire de la physique récente a été annoncée lors de la dernière assemblée de la Commission des Instruments scientifiques dont le numéro précédent des Archives *a donné le compte rendu succinct.*

L'article suivant, rédigé par le directeur de ce projet, a été adressé à M. André Léveillé, Président de la Commission des Instruments scientifiques, qui a bien voulu le communiquer à la Rédaction des Archives, *en accord avec l'auteur.*

La mise en œuvre du projet est réalisée parallèlement à l'Inventaire Mondial des Appareils Scientifiques historiques, mais en liaison étroite avec les organisateurs de cette entreprise. L'intérêt d'une telle enquête est évident. La rapidité du développement actuel pose à l'historien comme à l'informateur de grosses difficultés du fait de la disparition fréquente du matériel instrumental et de la masse considérable des travaux et des publications. L'un des problèmes les plus urgents est celui de la localisation et de la conservation des instruments ayant joué un rôle notable dans le processus de la découverte.

La Rédaction des Archives *est heureuse de publier ce document qui illustre l'ampleur de l'action récemment entreprise aux Etats-Unis pour pallier ces difficultés.*

On the recommendation of its Committee on the History and Philosophy of Science and with the assistance of a grant from the National Science Foundation, the American Institute of Physics has underaken a project on the history of recent physics in the United States. One part of the project will be to collect materials documenting the work of those twentieth century physicists who have made important contributions to the field, and to take steps towards the preservation of the materials so collected. Another part of the project will be to encourage and initiate historical researches upon these materials. Details of these plans are discussed below.

The American Institute of Physics is undertaking this work because it is becoming clear, as we shall see, that greater efforts must be made by the physics community to document and to write the story of recent American physics. There is no need to argue here the place of modern physics in American culture in its technological utility, its intellectual significance, or its impact upon contemporary society. Why this aspect of American culture has been left relatively untouched can be understood if we examine what has been done.

When we turn to the history of the earlier periods of physics, we find that the most important figures and their works are known, reasonably sound information about the course of their lives is on hand,